Progress Report No. 2
Quiet Pavement Pilot Program

December 20, 2005
Revised December 28, 2006

Progress Report No. 2
Quiet Pavement Pilot Program

December 20, 2005
Revised December 28, 2006

I. Introduction

This report summarizes activities completed to date on the Quiet Pavement Pilot Program (QPPP), a research program partnering the Federal Highway Administration (FHWA) and the Arizona Department of Transportation (ADOT). ADOT initiated the QPPP in April of 2003 after approval by FHWA.

The QPPP consists of two components: construction and research. The construction component consists of overlaying approximately 115 miles of existing urban freeways with asphalt rubber friction course (ARFC) in five separate phases. The research component evaluates the potential for using ARFC as a noise mitigation measure. A map of the Maricopa County Regional Freeway System is included in **Appendix 1**.

Overview

The research component of the QPPP consists of three separate technical studies designated as Site 1, Site 2, and Site 3. The studies at the three types of study sites, located on or adjacent to selected Maricopa County Regional Freeways, involve measuring traffic noise levels prior to applying ARFC (hereinafter referred to as *Before* measurements) and measuring traffic noise levels at the same measurement positions subsequent to the application of ARFC (hereinafter referred to as *After* measurements). Site 1 examines freeway noise reduction at the tire/pavement interface due to the application of ARFC. Site 2 examines noise reduction in urban residential neighborhoods associated with the application of ARFC to a nearby freeway segment. Site 3 evaluates noise reduction on adjacent properties and the longevity of the noise reduction benefit.

Stakeholders

ADOT's Arizona Transportation Research Center (ATRC) manages research project activities for Site 1 and Site 3. The Noise Team of ADOT's Environmental Planning Group (EPG) manages research project activities for Site 2. The State Engineer's Office provides overall project management (both the construction and research components) for ADOT. The Maricopa Association of Governments (MAG) participated in preliminary project planning and provided the majority of funding. Progress reports and research study results are submitted to FHWA.

ADOT's Use of ARFC

ADOT first used asphalt rubber products in 1964 and increased the use of asphalt rubber products in 1968. In 1985, ADOT placed the first non-experimental section of ARFC on I-17 in Phoenix, Arizona as part of a pavement preservation project. ADOT overlaid a 1.5-mile section of southbound I-19 near Tucson, Arizona in 1988 with a one-inch layer of ARFC; portions of this overlay are still in service today. The one-inch thick ARFC surfacing currently used by ADOT consists of a 3/8" minus, open-

graded aggregate mixed with asphalt-rubber binder that ranges from 9.0% to 9.6% by total mix weight. ADOT used this mix design for the majority of ARFC overlays placed since 1988.

Paving operations for the original five phases of ARFC overlay were initiated in July of 2003 and were completed in October 2005. An additional five phases of ARFC overlay were added to the construction component to eliminate gaps in the overlay. These additional five phases will not be included in the research component of the QPPP.

II. Program Description

ADOT requested formal approval of the Quiet Pavement Pilot Program from FHWA in April of 2003. The request letter included Attachment 5, which consisted of a detailed program description and work plan to manage the research. The ADOT letter requested approval to initiate a pilot study to evaluate the effectiveness of quiet pavement as a noise mitigation strategy. This pilot study documents the effectiveness of rubberized asphaltic friction course, and possibly other pavements, as a quiet pavement technology to reduce traffic noise on sections of the Regional Freeway System in Maricopa County.

III. Site 1

Description

Site 1 approaches source noise reduction data acquisition as a typical ADOT pavement management system (PMS) data collection activity. ADOT normally collects pavement attributes in the travel lane at every milepost. ADOT collected source noise reduction data for the QPPP as if it were a PMS collection activity.

Source noise reduction data consists of collecting *Before* and *After* noise measurements at the tire/pavement interface at every milepost within the program limits. Source noise reduction data was collected using a close proximity (CPX) trailer. Air and pavement temperatures were recorded simultaneous to collecting each source noise reduction measurement. *Before* and *After* source noise reduction measurements were collected in both travel directions on freeway segments receiving ARFC overlay.

Site 1 source noise reduction data will be collected bi-annually after the initial *Before* and *After* source measurements. The bi-annual measurements will help evaluate sustainability of source noise reductions over the life of the ARFC overlay, and to possibly evaluate seasonal effects on source noise reductions.

The source noise reduction data collected at the tire/pavement interface are defined as source measurements. All other noise measurements discussed relative to the remaining study sites are defined as wayside measurements.

Field Activities

Source noise reduction data was collected using a close proximity (CPX) trailer. Air and pavement temperatures were recorded simultaneous to collecting each source noise reduction measurement. Site 1 measurements consisted of obtaining a five-second sound spectrum at selected mileposts in the travel lane. A one-third octave analysis of the spectrum was performed. The acoustical data was collected

using a towable trailer constructed to the ISO standards for CPX testing. Testing was conducted at 60 miles per hour (mph) using both a Goodyear Aqua Tread III tire and a Uniroyal Tiger Paw tire. Results reported in this progress report pertain only to the Goodyear Aqua Tread III tire.

Results

The ARFC overlay consistently reduced tire/pavement noise at all Site 1 positions. Source noise reductions ranged from 4.1 dBA to 13.2 dBA. The average noise reduction measured at Site 1 positions is 8.3 dBA. The Site 1 data results are shown in **Appendix 2**.

Much of the Site 1 data was not available for inclusion in this progress report. The data must be converted from the data log files. Additional Site 1 data will be available for the next progress report.

IV. Site 2

Description

Site 2 data acquisition involves collecting *Before* and *After* noise measurements in residential neighborhoods adjacent to urban freeways overlaid with ARFC. Measurement positions were chosen to represent typical urban subdivisions because the purpose of the Site 2 study is to evaluate noise reductions in residential neighborhoods due to the application of ARFC overlays on the freeways. In addition, noise measurements were collected when freeway noise was anticipated to be loudest: Level of Service (LOS) C, defined as maximum traffic volume traveling at posted speeds; time of day when peak traffic volumes occur; maximum traffic volume days (Tuesday, Wednesday, or Thursday) and clear, calm weather.

Selected measurement positions will be modeled using the FHWA approved Traffic Noise Model (TNM), Version 2.5. The selected measurement positions will be modeled using program settings that represent existing conditions, including the presence or absence of noise barriers. The model will be set to "Average Pavement" to represent paving conditions. Site 2 modeling results will be compared to measured noise reductions as part of the process to assess wayside noise reductions adjacent to transversely tined PCCP pavement sections.

Four noise measurements will be collected at each position: one measurement prior to ARFC application; one measurement after ARFC application; and a subsequent set of two measurements completed in a calendar year (bi-annual measurements). The initial bi-annual noise measurements will be collected in the Spring and Fall at least one year after the date of overlay. Where possible, Site 2 bi-annual noise measurements will coincide with Site 1 and Site 3 measurements. The purpose of the bi-annual measurements will help confirm the sustainability of noise reductions in residential neighborhoods over the life of the ARFC overlay. Additional bi-annual noise measurements may be completed at selected Site 2 positions.

HDR Inc. (HDR) manages Site 2 research activities for ADOT. Technical reports summarizing Site 2 milestones completed by HDR will be included in upcoming progress reports.

Field Activities

Times of daily peak freeway noise levels were determined for each freeway segment by continuously monitoring traffic noise levels for 24 hours, establishing peak noise levels in the morning and evening. Three noise 20-minute noise measurements were recorded at each neighborhood position during either

the morning or evening peak traffic noise level. When three noise measurements differed by less than 3 decibels, noise measuring was terminated and the three measurements were averaged to provide a single noise level for the measurement position. Traffic volumes for the measurement period were determined by simultaneously recording traffic on videotape, then counting vehicle number and types in the office. The *After* noise measurements presented in the data table were adjusted for differences in traffic volume relative to the *Before* noise measurements. Each *After* noise measurement was normalized to the corresponding *Before* noise measurement using equivalent vehicle counts based on FHWA Traffic Noise Model (TNM) Reference Energy Mean Emission Levels and vehicle definitions in FHWA-PD-96-008, DOT-VNTSC-FHWA-96-2.

Air temperature, humidity, wind speed, and wind direction were recorded simultaneously with the noise measurement using field meteorological instruments. The immediate vicinity of each measurement site was sketched on the field data form and digitally photographed. Pertinent characteristics of each site were also recorded on the field data form.

ADOT collected meteorological data to document conditions existing at the time of each noise measurement as part of the process to evaluate measurement positions, particularly those positions that exhibit noise level reductions significantly greater or less than the target noise level reduction of 4 dBA for residential subdivisions. Noise measurements were not collected when wind speeds exceeded 12 mph.

Results

The ARFC overlay consistently reduced freeway noise at Site 2 positions. The average noise reduction was 5.39 dBA for the 78 measurements and noise reductions ranged from (+) 1.3 dBA to (-) 12.3 dBA. Noise reductions at 26 of the 78 Site 2 positions were less than 4.0 dBA, which represents 33 percent of the positions. Noise reductions at 20 of the 78 Site 2 positions were less than 3.5 dBA, which represents 26 percent of the positions. **Appendix 3** presents tables of *Before* and *After* measurements, including traffic data, weather conditions, and monitoring site characteristics.

Physical characteristics of Site 2 measurement positions may influence noise reduction attributed to ARFC overlay. These site characteristics include vertical or horizontal freeway alignment changes, the presence of noise barriers, the presence of existing buildings, the presence of heavy traffic on non-ARFC arterial roadways, ground surface composition, meteorology, external noise sources, freeway geometry, and topography. Site 2 noise measurement positions, including those positions exhibiting noise reductions of less than 4 dBA, will be evaluated in an upcoming progress report using site characteristics. The results of the site characteristics analysis will help determine the advisability of continuing to measure noise at a Site 2 position, especially for bi-annual measurements.

Noise reduction is desirable in other types of neighborhood sites, such as schools and parks. Another research organization, the Volpe Center, is conducting noise reduction measurements at a school and at a park. The methodologies for evaluating these noise reduction measurements are discussed in the next section.

V. Site 3

Description

Research quality data was collected at the five Site 3 study areas. The study areas are acoustically simple, and were selected to represent “Ideal Conditions” (for example, no intervening barriers or

potential for future barriers, topography varies by 2 feet or less, relatively flat topography with no slopes) and denote the highest quality field measurement sites. Although topography varied by more than 2 feet at some of the sites, the 5 foot height above the roadway plane for the 50 foot noise measurement position was preserved at all of the Site 3 study areas. The purpose of the Site 3 study is to evaluate the amount of noise reduction benefit in adjacent communities and the longevity of the noise reduction benefit.

The Site 3 study includes wayside noise measurements collected 50 feet from the centerline of the adjacent freeway travel lane. Acoustical, meteorological, traffic, and pavement data were collected at Site 3 positions. Data will be used to evaluate general pavement acoustical properties including determination of noise reduction in the community, and will be essential in confirming the application of a 4-decibel reduction to freeway noise analyses. ADOT currently is comparing the Site 3, five-minute Equivalent Sound Level (Leq, or average sound level) acoustic data to the environmental data. Full results of this comparison will be discussed in future QPPP progress reports.

Additional noise measurements were performed at Site 3B and Site 3C to evaluate benefit and longevity of noise reduction in special use areas such as schools, parks, outdoor theaters, hospitals, and churches. Site 3B is an elementary school located west of and adjacent to one of the QPPP freeways. Site 3C is a park located west of and adjacent to another of the QPPP freeways. These noise measurements were collected in addition to the typical Site 3 measurements and are included in the discussion of each Site 3 study area.

Field Activities

Wayside noise measurements were collected at five Site 3 study areas. Within each study area, a microphone was located 50 feet from the center of the outside travel lane at a height 5 feet above the roadway plane. This was considered the reference position. Noise measurements were collected at other positions and are described individually in subsequent paragraphs. The acoustic measurement positions vary by site except for the 50-foot position.

Environmental monitoring occurred at Sites 3A and 3D in addition to noise monitoring at the acoustic measurement positions. Three environmental towers were installed to record weather data at the Site 3A and 3D study areas. Wind speed and temperature were simultaneously recorded at heights of 2 meters and 6 meters. Environmental data will be compared to acoustic data in a future progress report.

Results

Methodologies and results of the Site 3 measurements are summarized in the following separate subsections. Site 3B data and Site 3C data are summarized in **Appendix 4**. Reports summarizing Sites 3A, 3D, and 3E will be included in a future progress report.

Site 3A Description

This study site is located on the north side of SR 101 (Agua Fria Freeway) between mileposts 20 and 21. SR 101 consists of three travel lanes in both directions plus an auxiliary lane in the westbound direction, all constructed of Portland cement concrete (PCC) with uniformly transverse tining. The frontage road (West Beardsley Road) consists of two westbound travel lanes constructed of asphaltic concrete (AC). An unlined ditch two-feet deep is located between the SR 101 travel lanes and the westbound frontage road, and a concrete-lined channel five-feet deep is located north of the westbound frontage road. The ground surface is naturally compacted earth with sparse desert vegetation. No large reflecting surfaces are present and the site provides an unobstructed view of the freeway in both

directions for an arc of more than 150 degrees. The study area is relatively level with little topographic variation. The Hedgpeth Hills are located approximately 400 feet north of the study area but have little affect on the noise measurements. West Beardsley Road (the westbound frontage road) is the only other noise source in the area; traffic was diverted from the frontage road during measurement activities.

Site 3A Noise Measurements

Wayside noise measurements were completed on August 7 and 8, 2003 (pre-ARFC overlay) and on September 28 and 29, 2004 (first post-overlay measurements). Field activities included measuring noise simultaneously at three positions, recording meteorological conditions, determining traffic counts, and estimating vehicle speeds.

Noise measurements were collected: 5 feet above the ground (5 feet above roadway plane) and 12 feet above the ground, 50 feet north of the center of the outside travel lane; 5 feet above the ground, 100 feet north of the center of the outside travel lane; and 5 feet above the ground, 175 feet north of the center of the outside travel lane. The four wayside noise measurements were collected simultaneously for two hours on each of the dates noted in Table 1.

Site 3A Traffic Noise Modeling

Site 3A was modeled using TNM, version 2.5. The purpose of this activity was to normalize variations in traffic so that *Before* and *After* noise measurements could be compared. The model was not used to test or validate modeled noise predictions against measured noise levels.

Site 3A Results

The wayside measurements are summarized in Table 1:

Table 1: Site 3A Wayside Noise Data

Position	Pre-Overlay				Post-Overlay			
	Date	Modeled	Measured	Difference	Date	Modeled	Measured	Difference
50ft/12ft	08/07/03	79.8 dBA	82.5 dBA	-2.7 dBA	09/28/04	--	74.3 dBA	--
50ft/12ft	08/08/03	79.6 dBA	82.7 dBA	-3.1 dBA	09/29/04	79.5 dBA	74.8 dBA	4.7 dBA
50ft/5ft	08/07/03	79.9 dBA	82.3 dBA	-2.4 dBA	09/28/04	--	74.4 dBA	--
50ft/5ft	08/08/03	79.8 dBA	81.0 dBA	-1.2 dBA	09/29/04	79.5 dBA	75.1 dBA	4.4 dBA
100ft/5ft	08/07/03	77.5 dBA	76.7 dBA	+0.8 dBA	09/28/04	--	70.3 dBA	--
100ft/5ft	08/08/03	77.5 dBA	72.2 dBA	+5.3 dBA	09/29/04	77.2 dBA	71.3 dBA	5.9 dBA
175ft/5ft	08/07/03	--	--	--	09/28/04	--	68.5 dBA	--
175ft/5ft	08/08/03	--	--	--	09/29/04	74.6 dBA	66.9 dBA	7.7 dBA

Differences in traffic volume and vehicle types occurring between the *Before* and *After* noise measurements must be considered when calculating reduction in noise levels. The noise levels predicted by TNM 2.5 for the conditions on consecutive days were averaged into a single value for each position. The measured noise levels for each position were also averaged into a single value. The difference between the modeled value and the measured value were computed at each position. The post-overlay difference was subtracted from the pre-overlay difference to determine the noise reduction at each measurement position corrected for traffic variations.

Table 2 summarizes the noise reduction data:

Table 2: Site 3A Wayside Noise Reduction

Position	Pre-Overlay (Averaged)			Post-Overlay (Averaged)			Noise Reduction
	Modeled	Measured	Difference	Modeled	Measured	Difference	
50ft/12ft	79.8 dBA	82.5 dBA	-2.7 dBA	79.5 dBA	74.8 dBA	4.7 dBA	-7.4 dBA
50ft/5ft	79.9 dBA	82.3 dBA	-2.4 dBA	79.5 dBA	75.1 dBA	4.4 dBA	-6.8 dBA
100ft/5ft	77.5 dBA	76.7 dBA	+0.8 dBA	77.2 dBA	71.3 dBA	5.9 dBA	-5.1 dBA
175ft/5ft	--	--	--	74.6 dBA	66.9 dBA	--	--

Site 3B Description

This study site (Sun Valley Elementary School) is located on the west side of SR 101 between mileposts 8 and 9. SR 101 consists of three travel lanes in both directions, all constructed of Portland cement concrete (PCC) with uniformly transverse tining and no expansion joints. The ground surface is naturally compacted earth with sparse vegetation. No large reflecting surfaces are present and the site provides an unobstructed view of the freeway in both directions for an arc of more than 150 degrees. The study area is relatively level with little topographic variation.

Site 3B Noise Measurements

Wayside noise measurements were completed in June 2004 (pre-ARFC overlay) and in August 2005 (first post-overlay measurement). Field activities included measuring noise simultaneously at three positions, recording meteorological conditions, determining traffic counts, and estimating vehicle speeds.

Noise measurements were collected: 10 feet above the ground (5 feet above roadway plane), 50 feet north of the center of the outside travel lane; 5 feet above the ground, 95 feet north of the center of the outside travel lane; and 5 feet above the ground, 246 feet north of the center of the outside travel lane. The five wayside noise measurements were collected simultaneously for four hours on each of the dates noted in Table 3.

Site 3B Traffic Noise Modeling

Site 3B was modeled using TNM 2.5. The purpose of this activity was to normalize variations in traffic so that *Before* and *After* noise measurements could be compared. The model was not used to test or validate modeled noise predictions against measured noise levels.

Site 3B Results

The wayside measurements are summarized in Table 3:

Table 3: Site 3B Wayside Noise Data

Position	Pre-Overlay				Post-Overlay			
	Date	Modeled	Measured	Difference	Date	Modeled	Measured	Difference
50ft/10ft	06/17/04	In progress	82.9 dBA	--	08/24/05	In progress	74.1 dBA	--
95ft/5ft	06/17/04	In progress	76.9 dBA	--	08/24/05	In progress	70.2 dBA	--
246ft/5ft	06/17/04	In progress	70.3 dBA	--	08/24/05	In progress	62.0 dBA	--
Classroom	06/17/04	In progress	52.9 dBA	--	08/24/05	In progress	51.1 dBA	--
Amphitheater	06/17/04	In progress	68.1 dBA	--	08/24/05	In progress	63.7 dBA	--

Differences in traffic volume and vehicle types occurring between the *Before* and *After* noise measurements must be considered when calculating reduction in noise levels. The reduction in noise

levels will be normalized for differences in traffic volume and vehicle types using the method described in the previous section summarizing Site 3A.

Table 4 summarizes the noise reduction data:

Table 4: Site 3B Wayside Noise Reduction (Traffic Normalization In Progress)

Position	Pre-Overlay (Averaged)			Post-Overlay (Averaged)			Noise Reduction
	Modeled	Measured	Difference	Modeled	Measured	Difference	
50ft/10ft	In progress	82.9 dBA	--	In progress	74.1 dBA	--	-8.7 dBA
95ft/5ft	In progress	76.9 dBA	--	In progress	70.2 dBA	--	-6.7 dBA
246ft/5ft	In progress	70.3 dBA	--	In progress	62.0 dBA	--	-8.3 dBA
Classroom	In progress	52.9 dBA	--	In progress	51.1 dBA	--	-1.8 dBA
Amphitheater	In progress	68.1 dBA	--	In progress	63.7 dBA	--	-4.4 dBA

The noise reduction values may change slightly once the measured values are normalized for differences in traffic.

Site 3C Description

This study site (Mountain Vista Park) is located on the west side of Interstate 10 (I-10) between mileposts 159 and 160. I-10 consists of four travel lanes and an HOV lane in both directions, all constructed of Portland cement concrete (PCC) with uniformly transverse tining and expansion joints. The ground surface is naturally compacted earth with sparse vegetation. No large reflecting surfaces are present and the site provides an unobstructed view of the freeway in both directions for an arc of more than 150 degrees. The study area is relatively level with little topographic variation.

Site 3C Noise Measurements

Wayside noise measurements were completed in June 2004 (pre-ARFC overlay) and in June 2005 (first post-overlay measurement). Field activities included measuring noise simultaneously at two positions, recording meteorological conditions, determining traffic counts, and estimating vehicle speeds.

Noise measurements were collected: 9.5 feet above the ground (5 feet above roadway plane), 50 feet north of the center of the outside travel lane; and 5 feet above the ground, 141 feet north of the center of the outside travel lane. The two wayside noise measurements were collected simultaneously for two hours on the dates noted in Table 5.

Site 3C Traffic Noise Modeling

Site 3C was modeled using TNM 2.5. The purpose of this activity was to normalize variations in traffic so that *Before* and *After* noise measurements could be compared. The model was not used to test or validate modeled noise predictions against measured noise levels.

Site 3C Results

The wayside measurements are summarized in Table 5:

Table 5: Site 3C Wayside Noise Data

Position	Pre-Overlay				Post-Overlay			
	Date	Modeled	Measured	Difference	Date	Modeled	Measured	Difference
50ft/9.5ft	06/16/04	In progress	82.9 dBA	--	06/07/05	In progress	75.3 dBA	--
141ft/5ft	06/16/04	In progress	72.4 dBA	--	06/07/05	In progress	66.9 dBA	--

Differences in traffic volume and vehicle types occurring between the *Before* and *After* noise measurements must be considered when calculating reduction in noise levels. The reduction in noise levels will be normalized for differences in traffic volume and vehicle types using the method described in the previous section summarizing Site 3A.

Table 6 summarizes the noise reduction data:

Table 6: Site 3C Wayside Noise Reduction (Traffic Normalization In Progress)

Position	Pre-Overlay (Averaged)			Post-Overlay (Averaged)			Noise Reduction
	Modeled	Measured	Difference	Modeled	Measured	Difference	
50ft/9.55ft	In progress	82.9 dBA	--	In progress	75.3 dBA	--	-7.6 dBA
141ft/5ft	In progress	72.4 dBA	--	In progress	66.9 dBA	--	-5.6 dBA

The noise reduction values will probably change slightly once the measured values are normalized for differences in traffic.

Site 3D Description

This study site is located on the north side of SR 202 between mileposts 18 and 19. SR 202 consists of three travel lanes in both directions; travel lanes are constructed of Portland cement concrete (PCC) with random transverse tining. It should be noted that this is the only Site 3 study site adjacent to a concrete pavement section with random transverse tining. The ground surface is naturally compacted earth with sparse vegetation. No large reflecting surfaces are present and the site provides an unobstructed view of the freeway in both directions for an arc of more than 150 degrees. The study area has little topographic variation and the surface of the freeway is at the same relative height as the surrounding ground surface. No other apparent noise sources were present except for occasional aircraft overflights.

Site 3D Noise Measurements

Wayside noise measurements were completed on October 16 and 17, 2003 (pre-ARFC overlay) and on October 5 and 6, 2004 (first post-overlay measurements). Field activities included measuring noise simultaneously at three positions, recording meteorological conditions, determining traffic counts, and estimating vehicle speeds.

Noise measurements were collected: 5 feet above the ground (5 feet above roadway plane) and 12 feet above the ground, 50 feet north of the center of the outside travel lane; 5 feet above the ground, 100 feet north of the center of the outside travel lane; and 5 feet above the ground, 250 feet north of the center of the outside travel lane. The four wayside noise measurements were collected simultaneously for two hours on each of the dates noted in Table 7.

Site 3D Traffic Noise Modeling

Site 3D was modeled using TNM 2.5. The purpose of this activity was to normalize variations in traffic so that *Before* and *After* noise measurements could be compared. The model was not used to test or validate modeled noise predictions against measured noise levels.

Site 3D Results

The wayside measurements are summarized in Table 7:

Table 7: Site 3D Wayside Noise Data

Position	Pre-Overlay				Post-Overlay			
	Date	Modeled	Measured	Difference	Date	Modeled	Measured	Difference
50ft/12ft	10/16/03	73.8 dBA	82.8 dBA	-9.0 dBA	10/05/04	74.0 dBA	70.8 dBA	3.2 dBA
50ft/12ft	10/17/03	76.4 dBA	85.8 dBA	-9.4 dBA	10/06/04	74.1 dBA	71.0 dBA	3.2 dBA
50ft/5ft	10/16/03	73.9 dBA	81.7 dBA	-7.8 dBA	10/05/04	74.1 dBA	70.8 dBA	3.3 dBA
50ft/5ft	10/17/03	76.4 dBA	84.6 dBA	-8.2 dBA	10/06/04	74.2 dBA	71.0 dBA	3.2 dBA
100ft/5ft	10/16/03	71.6 dBA	75.4 dBA	-3.8 dBA	10/05/04	71.8 dBA	65.6 dBA	6.2 dBA
100ft/5ft	10/17/03	74.1 dBA	78.1 dBA	-4.0 dBA	10/06/04	71.9 dBA	65.7 dBA	6.2 dBA
250ft/5ft	10/16/03	66.8 dBA	67.6 dBA	-0.9 dBA	10/05/04	66.8 dBA	59.7 dBA	7.0 dBA
250ft/5ft	10/17/03	69.2 dBA	70.2 dBA	-1.1dBA	10/06/04	67.0 dBA	59.7 dBA	7.2 dBA

Differences in traffic volume and vehicle types occurring between the *Before* and *After* noise measurements must be considered when calculating reduction in noise levels. The noise levels predicted by TNM 2.5 for the conditions on consecutive days were averaged into a single value for each position. The measured noise levels for each position were also averaged into a single value. The difference between the modeled value and the measured value were computed at each position. The post-overlay difference was subtracted from the pre-overlay difference to determine the noise reduction at each measurement position corrected for traffic variations.

Table 8 summarizes the noise reduction data:

Table 8: Site 3D Wayside Noise Reduction

Position	Pre-Overlay (Averaged)			Post-Overlay (Averaged)			Noise Reduction
	Modeled	Measured	Difference	Modeled	Measured	Difference	
50ft/12ft	75.1 dBA	84.3 dBA	-9.2 dBA	74.0 dBA	70.9 dBA	3.1 dBA	-12.4 dBA
50ft/5ft	75.1 dBA	83.1 dBA	-8.0 dBA	74.1 dBA	70.9 dBA	3.2 dBA	-11.3 dBA
100ft/5ft	72.8 dBA	76.7 dBA	-3.9 dBA	71.8 dBA	65.6 dBA	6.2 dBA	-10.1 dBA
250ft/5ft	68.0 dBA	68.9 dBA	-0.9 dBA	66.9 dBA	59.7 dBA	7.2 dBA	-8.1 dBA

Site 3E Description

This study site is located on the west side of SR 101 at milepost 47. SR 101 consists of three travel lanes in both directions and an outside auxiliary lane in both directions, all constructed of Portland cement concrete (PCC) with uniform transverse tining. The ground surface is naturally compacted earth with sparse vegetation. No large reflecting surfaces are present and the site provides an unobstructed view of the freeway in both directions for an arc of more than 150 degrees. The study area has little topographic variation, although the presence of an embankment elevates the surface of the freeway slightly above the surrounding ground surface, providing some shielding. No other apparent noise sources were present. The southbound auxiliary lane is located about 40 feet from the nearest noise measurement position.

Site 3E Noise Measurements

Wayside noise measurements were completed on April 6 and 7, 2004 (pre-ARFC overlay) and on October 19 and 20, 2004 (first post-overlay measurements). Field activities included measuring noise simultaneously at three positions, recording meteorological conditions, determining traffic counts, and estimating vehicle speeds.

Noise measurements were collected: 5 feet above the ground and 12 feet above the ground 5 feet above roadway plane), 50 feet north of the center of the outside travel lane; and 5 feet above the ground, 100 feet north of the center of the outside travel lane. The four wayside noise measurements were collected simultaneously for two hours on each of the dates noted in Table 9.

Site 3E Traffic Noise Modeling

Site 3E was modeled using TNM 2.5. The purpose of this activity was to normalize variations in traffic so that *Before* and *After* noise measurements could be compared. The model was not used to test or validate modeled noise predictions against measured noise levels.

Site 3E Results

The wayside measurements are summarized in Table 9:

Table 9: Site 3E Wayside Noise Data

Position	Pre-Overlay				Post-Overlay			
	Date	Modeled	Measured	Difference	Date	Modeled	Measured	Difference
50ft/12ft	04/06/04	80.1 dBA	84.1 dBA	-4.0 dBA	10/19/04	79.8 dBA	74.9 dBA	4.9 dBA
50ft/12ft	04/07/04	80.3 dBA	84.3 dBA	-4.0 dBA	10/20/04	79.9 dBA	74.9 dBA	5.0 dBA
50ft/5ft	04/06/04	79.8 dBA	81.6 dBA	-1.8 dBA	10/19/04	79.8 dBA	73.4 dBA	6.4 dBA
50ft/5ft	04/07/04	80.1 dBA	81.6 dBA	-1.5 dBA	10/20/04	79.9 dBA	73.0 dBA	6.9 dBA
100ft/5ft	04/06/04	76.7 dBA	78.8 dBA	-2.1 dBA	10/19/04	76.8 dBA	69.8 dBA	7.0 dBA
100ft/5ft	04/07/04	77.0 dBA	78.5 dBA	-1.5 dBA	10/20/04	76.9 dBA	69.8 dBA	7.1 dBA

Differences in traffic volume and vehicle types occurring between the *Before* and *After* noise measurements must be considered when calculating reduction in noise levels. The noise levels predicted by TNM 2.5 for the conditions on consecutive days were averaged into a single value for each position. The measured noise levels for each position were also averaged into a single value. The difference between the modeled value and the measured value were computed at each position. The post-overlay difference was subtracted from the pre-overlay difference to determine the noise reduction at each measurement position corrected for traffic variations.

Table 10 summarizes the noise reduction data:

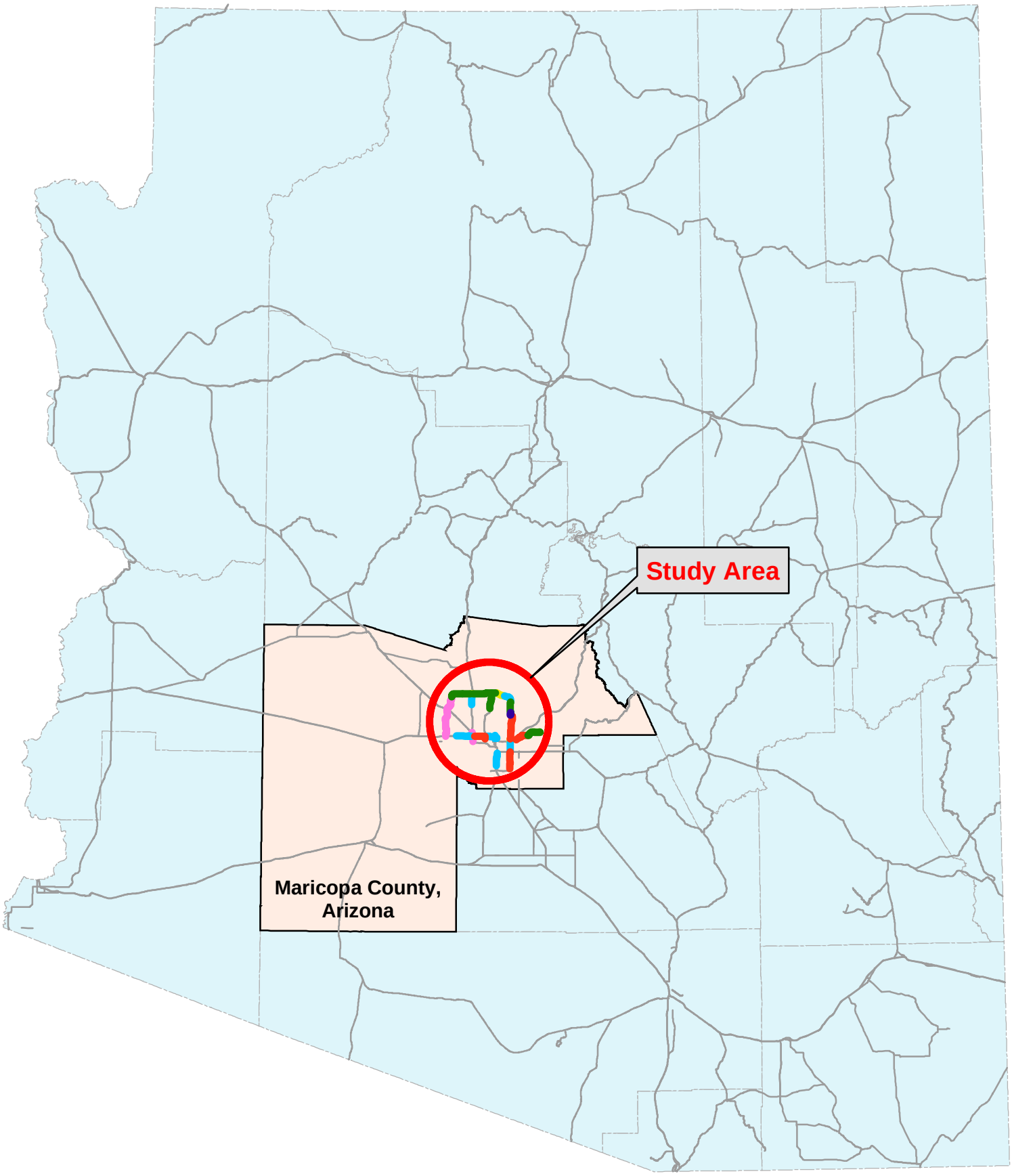
Table 10: Site 3E Wayside Noise Reduction

Position	Pre-Overlay (Averaged)			Post-Overlay (Averaged)			Noise Reduction
	Modeled	Measured	Difference	Modeled	Measured	Difference	
50ft/12ft	80.2 dBA	84.2 dBA	-4.0 dBA	79.8 dBA	74.9 dBA	5.0 dBA	-9.0 dBA
50ft/5ft	79.9 dBA	81.6 dBA	-1.7 dBA	79.8 dBA	73.2 dBA	6.6 dBA	-8.3 dBA
100ft/5ft	76.9 dBA	78.6 dBA	-1.7 dBA	76.8 dBA	69.8 dBA	7.0 dBA	-8.7 dBA

APPENDIX 1

Figures

Quiet Pavement Pilot Program
Study Area
December 2005



Quiet Pavement Pilot Program
MAG Regional Freeway System
December 2005

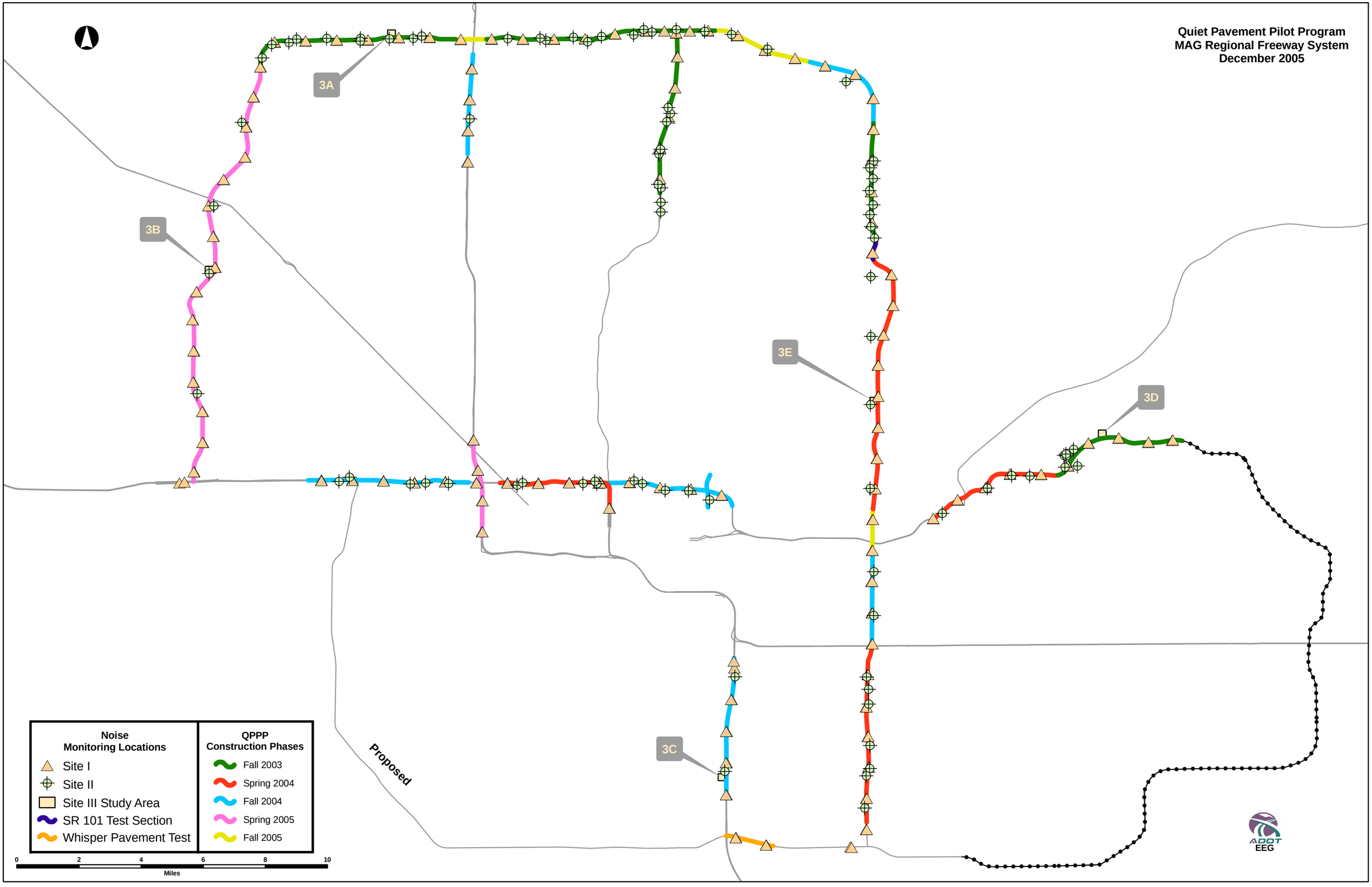
SR 101
SR 101
US 60
I-17
SR 101
SR 51
SR 87
SR 101
I-10
SR 202
SR 202
Under Construction
I-10
I-17
I-10
SR 101
US 60
I-10
SR 101
Construction
Proposed
SR 202
Under

ARFC Overlay Schedule
- Fall 2003
- Spring 2004
- Fall 2004
- Spring 2005
- Fall 2005

0 2 4 6 8 10
Miles

ADOT EEG

Quiet Pavement Pilot Program
MAG Regional Freeway System
December 2005



Quiet Pavement Pilot Program
Noise Measurement Positions
Agua Fria Freeway
December 2005

Freeway

Site 3A

Site 3B

Fria

Agua

SR 101

I-10

I-17

26 17 27 24 18 23 19 22 21 30 21 22 23

25 16

15

82 14

13

12

84 11

10

9

85 8

7

6

5

86

4

3

2

1.21

73

65 69 66 67 68

Construction Phases
and
Measurement Positions

- Site I Milepost
- Site II
- Site III Study Area
- Fall 2003
- Spring 2004
- Fall 2004
- Spring 2005
- Fall 2005

0 0.5 1 1.5 2
Miles

ADOT EEG

Quiet Pavement Pilot Program
Noise Measurement Positions
Pima Freeway
December 2005

SR 101

SR 51

I-17

I-10

SR 202

Pima Freeway

Site 3E

Construction Phases and Measurement Postions

Site I Milepost
Site II
Site III Study Area
Fall 2003
Spring 2004
Fall 2004
Spring 2005
Fall 2005

0 1 2 3 4
Miles

ADOT EEG

Quiet Pavement Pilot Program
Noise Measurement Positions
Price Freeway
December 2005

SR 202

I-10

US 60

Freeway

Price

I-10

SR 101

SR 202

52
75
53
54
76
55
56
45
51
57
50
58
49
59
48
46
60
47
61
61.95
70
71

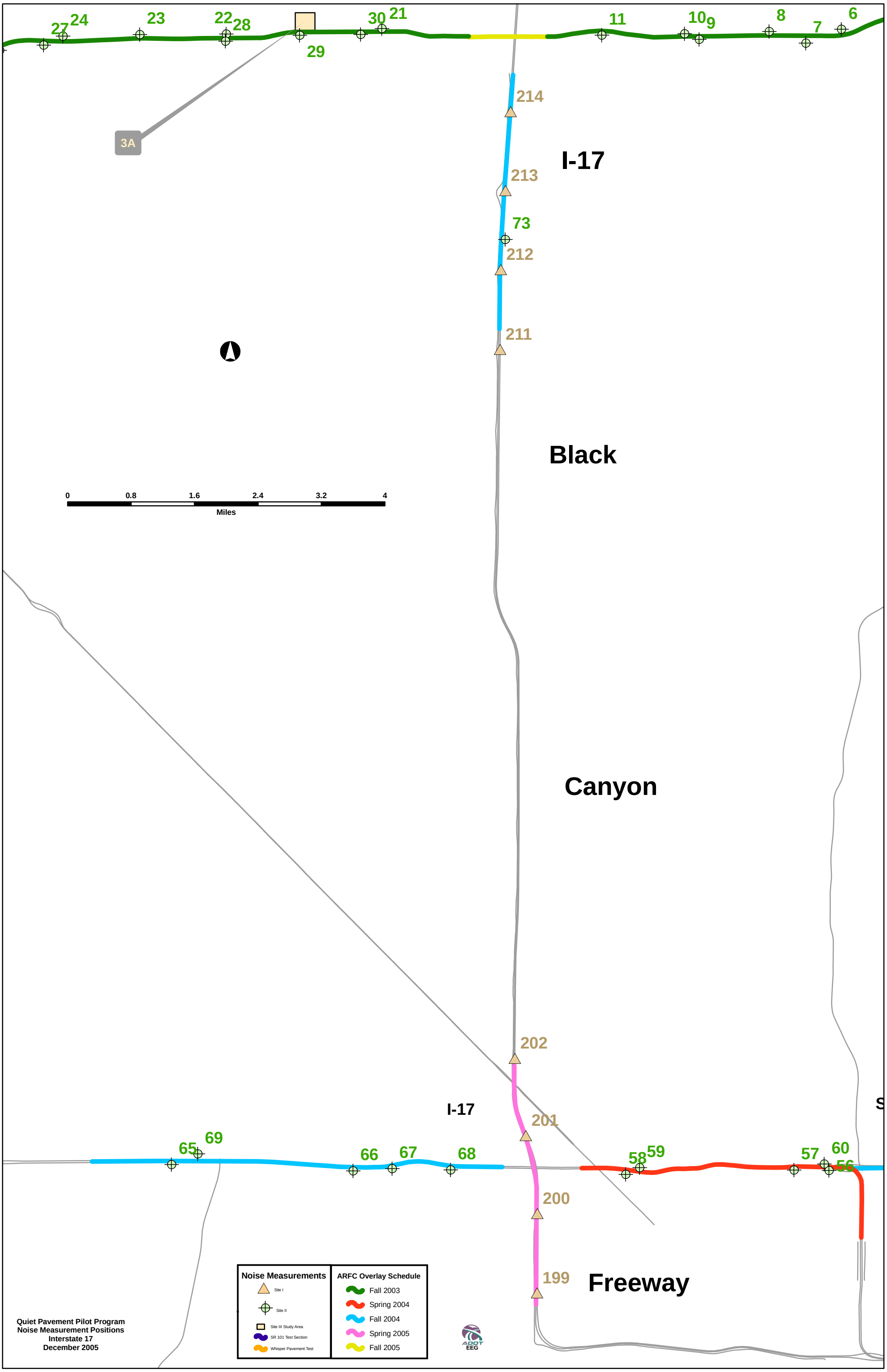
Site 3C

Construction Phases and Measurement Postions

- Site I Milepost
- Site II
- Site III Study Area
- Fall 2003
- Spring 2004
- Fall 2004
- Spring 2005
- Fall 2005

0 0.6 1.2 1.8 2.4
Miles

ADOT EEG


27
24
23
22
28
29
30
21
11
10
9
8
7
6
3A
214
213
73
212
211
I-17
Black
0
0.8
1.6
2.4
3.2
4
Miles
Canyon
202
201
200
199
I-17
Freeway
65
69
66
67
68
58
59
57
60
56
Noise Measurements
Site I
Site II
Site III Study Area
SR 101 Test Section
Whisper Pavement Test
ARFC Overlay Schedule
Fall 2003
Spring 2004
Fall 2004
Spring 2005
Fall 2005
ADOT
EEG
Quiet Pavement Pilot Program
Noise Measurement Positions
Interstate 17
December 2005

Quiet Pavement Pilot Program
Noise Measurement Positions
SR 51
December 2005

SR 51

Piestewa

I-17

Freeway

Noise Measurement Positions	ARFC Overlay Schedule
Site I	Fall 2003
Site II	Spring 2004
Site III Study Area	Fall 2004
	Spring 2005
	Fall 2005

0 0.8 1.6 2.4 3.2 4
Miles

Quiet Pavement Pilot Program
Noise Measurement Positions
Interstate 10
December 2005

SR 101

I-10

I-17

SR 51

Papago

Freeway

I-10

SR 202

I-17

Maricopa

US 60

Freeway

3C

Proposed

SR 202

I-10

138 69 139 140 66 141 142 143 144 59 145 146 57 60 147 78 79 80 81 77

65 67 68 58 56 148

156 70 157 158 159 71 160

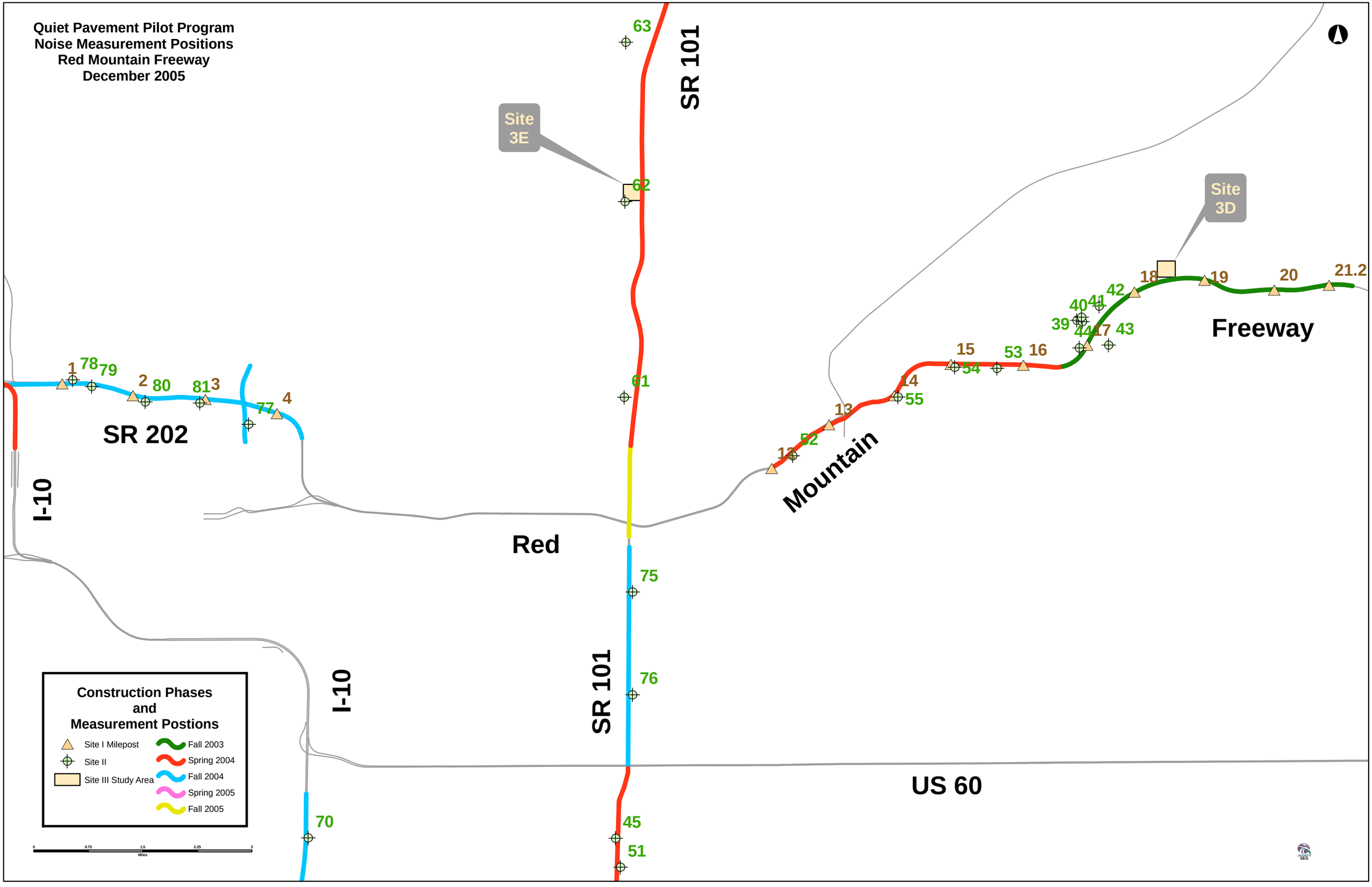
0 1 2 3 4 5
Miles

Noise Measurement Positions
- Site I
- Site II
- Site III Study Area
- SR 101 Test Section
- Whisper Pavement Test

ARFC Overlay Schedule
- Fall 2003
- Spring 2004
- Fall 2004
- Spring 2005
- Fall 2005

ADOT EEG

Quiet Pavement Pilot Program
Noise Measurement Positions
Red Mountain Freeway
December 2005



APPENDIX 2

Site 1 Data

Quiet Pavement Pilot Program
Site I (Mileposts) Data
12/07/05

ROUTE	ROAD NAME	ELEVATION	MP NUMBER	MP	DIRECTION	DATE1	BEFORE	DATE2	AFTER	REDUCTION
S 101	Agua Fria	0	1.21	0	NB					
S 101	Agua Fria	0	2	2	NB					
S 101	Agua Fria	0	3	3	NB					
S 101	Agua Fria	0	4	4	NB					
S 101	Agua Fria	0	5	5	NB					
S 101	Agua Fria	0	6	6	NB					
S 101	Agua Fria	0	7	7	NB					
S 101	Agua Fria	1082	8	8	NB					
S 101	Agua Fria	1105	9	9	NB					
S 101	Agua Fria	1121	10	10	NB					
S 101	Agua Fria	1123	11	11	NB					
S 101	Agua Fria	1152	12	12	NB					
S 101	Agua Fria	1171	13	13	NB					
S 101	Agua Fria	1188	14	14	NB					
S 101	Agua Fria	1208	15	15	NB					
S 101	Agua Fria	1232	16	16	NB	09/08/2003	100.4		94.5	5.9
S 101	Agua Fria	1245	17	17	NB	09/08/2003	100.2		93.5	6.7
S 101	Agua Fria	0	18	18	NB	09/08/2003	101.5		94.0	7.5
S 101	Agua Fria	0	19	19	NB	09/08/2003	101.3		94.4	6.9
S 101	Agua Fria	0	20	20	NB	09/08/2003	101.1		93.4	7.7
S 101	Agua Fria	0	21	21	NB	09/08/2003	101.6		93.2	8.4
S 101	Agua Fria	0	22	22	NB	09/08/2003	101.8		94.2	7.6
S 101	Agua Fria	0	1.21	0	SB					
S 101	Agua Fria	0	2	2	SB					
S 101	Agua Fria	0	3	3	SB					
S 101	Agua Fria	0	4	4	SB					
S 101	Agua Fria	0	5	5	SB					
S 101	Agua Fria	0	6	6	SB					
S 101	Agua Fria	0	7	7	SB					
S 101	Agua Fria	1082	8	8	SB					
S 101	Agua Fria	1105	9	9	SB					
S 101	Agua Fria	1121	10	10	SB					
S 101	Agua Fria	1123	11	11	SB					
S 101	Agua Fria	1152	12	12	SB					
S 101	Agua Fria	1171	13	13	SB					
S 101	Agua Fria	1188	14	14	SB					
S 101	Agua Fria	1208	15	15	SB					
S 101	Agua Fria	1232	16	16	SB					
S 101	Agua Fria	1245	17	17	SB					

Quiet Pavement Pilot Program
Site I (Mileposts) Data
12/07/05

ROUTE	ROAD NAME	ELEVATION	MP NUMBER	MP	DIRECTION	DATE1	BEFORE	DATE2	AFTER	REDUCTION
S 101	Agua Fria	0	18	18	SB					
S 101	Agua Fria	0	19	19	SB					
S 101	Agua Fria	0	20	20	SB					
S 101	Agua Fria	0	21	21	SB					
S 101	Agua Fria	0	22	22	SB					
S 101	Pima	0	23	23	NB	09/08/2003	103.3			
S 101	Pima	0	24	24	NB	08/05/2003	101.2			
S 101	Pima	0	25	25	NB	08/05/2003	98.7		93.1	5.6
S 101	Pima	0	26	26	NB	08/05/2003	99.1			
S 101	Pima	0	27	27	NB	08/05/2003	98.6			
S 101	Pima	0	28	28	NB	08/05/2003	98.5		93.3	5.2
S 101	Pima	0	29	29	NB	09/08/2003	103.3			
S 101	Pima	0	30	30	NB	09/08/2003	101.0			
S 101	Pima	0	31	31	NB	09/08/2003	100.7		94.4	6.3
S 101	Pima	0	32	32	NB	09/08/2003	102.2			
S 101	Pima	0	33	33	NB	09/08/2003	98.9			
S 101	Pima	0	34	34	NB	09/08/2003	98.8			
S 101	Pima	0	35	35	NB	09/08/2003	104.2		93.5	10.7
S 101	Pima	0	36	36	NB	09/08/2003	104.2		94.0	10.2
S 101	Pima	0	37	37	NB	09/08/2003	99.3		92.9	6.4
S 101	Pima	0	38	38	NB	09/08/2003	99.9		93.8	6.1
S 101	Pima	0	39	39	NB	09/08/2003	99.3		94.2	5.1
S 101	Pima	0	40	40	NB	09/08/2003	100.4		93.1	7.3
S 101	Pima	0	41	41	NB	09/08/2003	97.3		93.2	4.1
S 101	Pima	0	42	42	NB				95.4	
S 101	Pima	0	43	43	NB	03/16/2004	102.6			
S 101	Pima	0	44	44	NB	03/16/2004	102.6		94.7	7.9
S 101	Pima	0	45	45	NB	03/16/2004	100.8			
S 101	Pima	0	46	46	NB					
S 101	Pima	0	47	47	NB	03/16/2004	102.3		93.9	8.4
S 101	Pima	0	48	48	NB	03/16/2004	102.1		93.5	8.6
S 101	Pima	0	49	49	NB				95.0	
S 101	Pima	0	50	50	NB				95.0	
S 101	Pima	0	51	51	NB	03/16/2004	102.3		95.1	7.2
S 101	Pima	0	23	23	SB					
S 101	Pima	0	24	24	SB					
S 101	Pima	0	25	25	SB					
S 101	Pima	0	26	26	SB					
S 101	Pima	0	27	27	SB					

Quiet Pavement Pilot Program
Site I (Mileposts) Data
12/07/05

ROUTE	ROAD NAME	ELEVATION	MP NUMBER	MP	DIRECTION	DATE1	BEFORE	DATE2	AFTER	REDUCTION
S 101	Pima	0	28	28	SB					
S 101	Pima	0	29	29	SB					
S 101	Pima	0	30	30	SB					
S 101	Pima	0	31	31	SB					
S 101	Pima	0	32	32	SB					
S 101	Pima	0	33	33	SB					
S 101	Pima	0	34	34	SB					
S 101	Pima	0	35	35	SB					
S 101	Pima	0	36	36	SB					
S 101	Pima	0	37	37	SB					
S 101	Pima	0	38	38	SB					
S 101	Pima	0	39	39	SB					
S 101	Pima	0	40	40	SB					
S 101	Pima	0	41	41	SB					
S 101	Pima	0	42	42	SB					
S 101	Pima	0	43	43	SB					
S 101	Pima	0	44	44	SB					
S 101	Pima	0	45	45	SB					
S 101	Pima	0	46	46	SB					
S 101	Pima	0	47	47	SB					
S 101	Pima	0	48	48	SB					
S 101	Pima	0	49	49	SB					
S 101	Pima	0	50	50	SB					
S 101	Pima	0	51	51	SB					
S 101	Price	0	52	52	NB				95.0	
S 101	Price	0	53	53	NB					
S 101	Price	0	54	54	NB					
S 101	Price	0	55	55	NB				92.7	
S 101	Price	0	56	56	NB	03/16/2004	104.0		93.3	10.7
S 101	Price	0	57	57	NB	03/16/2004	104.3		94.0	10.3
S 101	Price	0	58	58	NB	03/16/2004	105.3		93.6	11.7
S 101	Price	0	59	59	NB	03/16/2004	105.1		93.5	11.6
S 101	Price	0	60	60	NB	03/16/2004	102.6		94.8	7.8
S 101	Price	0	61	61	NB		100.9		93.9	7.0
S 101	Price	0	61.95	0	NB					
S 101	Price	0	52	52	SB					
S 101	Price	0	53	53	SB					
S 101	Price	0	54	54	SB					
S 101	Price	0	55	55	SB					

Quiet Pavement Pilot Program
Site I (Mileposts) Data
12/07/05

ROUTE	ROAD NAME	ELEVATION	MP NUMBER	MP	DIRECTION	DATE1	BEFORE	DATE2	AFTER	REDUCTION
S 101	Price	0	56	56	SB					
S 101	Price	0	57	57	SB					
S 101	Price	0	58	58	SB					
S 101	Price	0	59	59	SB					
S 101	Price	0	60	60	SB					
S 101	Price	0	61	61	SB					
S 101	Price	0	61.95	0	SB					
I 17	Black Canyon		199		NB					
I 17	Black Canyon		200		NB					
I 17	Black Canyon		201		NB					
I 17	Black Canyon		202		NB		97.4			
I 17	Black Canyon		211		NB					
I 17	Black Canyon		212		NB					
I 17	Black Canyon		213		NB					
I 17	Black Canyon		214		NB					
I 17	Black Canyon		199		SB					
I 17	Black Canyon		200		SB					
I 17	Black Canyon		201		SB					
I 17	Black Canyon		202		SB		96.3			
I 17	Black Canyon		211		SB					
I 17	Black Canyon		212		SB					
I 17	Black Canyon		213		SB					
I 17	Black Canyon		214		SB					
SR 51	Piestewa		10		NB	08/15/2003	100.4			
SR 51	Piestewa		11		NB	08/15/2003	101.7			
SR 51	Piestewa		12		NB	08/15/2003	101.0			
SR 51	Piestewa		13		NB	08/15/2003	100.0			
SR 51	Piestewa		14		NB	08/15/2003			95.6	
SR 51	Piestewa		15		NB	08/15/2003			92.7	
SR 51	Piestewa		10		SB	08/15/2003	101.3			
SR 51	Piestewa		11		SB	08/15/2003	100.6			
SR 51	Piestewa		12		SB	08/15/2003	101.0			
SR 51	Piestewa		13		SB	08/15/2003	102.6			
SR 51	Piestewa		14		SB				92.1	
SR 51	Piestewa		15		SB				94.1	
I 10	Papago		137		EB					
I 10	Papago		138		EB					
I 10	Papago		139		EB					
I 10	Papago		140		EB					

Quiet Pavement Pilot Program
Site I (Mileposts) Data
12/07/05

ROUTE	ROAD NAME	ELEVATION	MP NUMBER	MP	DIRECTION	DATE1	BEFORE	DATE2	AFTER	REDUCTION
I 10	Papago		141		EB					
I 10	Papago		142		EB					
I 10	Papago		137		WB					
I 10	Papago		138		WB					
I 10	Papago		139		WB					
I 10	Papago		140		WB					
I 10	Papago		141		WB					
I 10	Papago		142		WB					
I 10	Maricopa		144		EB					
I 10	Maricopa		145		EB					
I 10	Maricopa		146		EB					
I 10	Maricopa		147		EB					
I 10	Maricopa		148		EB					
I 10	Maricopa		144		WB					
I 10	Maricopa		145		WB					
I 10	Maricopa		146		WB					
I 10	Maricopa		147		WB					
I 10	Maricopa		148		WB					
I 10	Maricopa		156		EB					
I 10	Maricopa		157		EB					
I 10	Maricopa		158		EB					
I 10	Maricopa		159		EB					
I 10	Maricopa		160		EB					
I 10	Maricopa		156		WB					
I 10	Maricopa		157		WB					
I 10	Maricopa		158		WB					
I 10	Maricopa		159		WB					
I 10	Maricopa		160		WB					
SR 202	Red Mountain		1		EB					
SR 202	Red Mountain		2		EB					
SR 202	Red Mountain		3		EB					
SR 202	Red Mountain		4		EB					
SR 202	Red Mountain		5		EB					
SR 202	Red Mountain		1		WB			11/04/2004	92.7	
SR 202	Red Mountain		2		WB			11/04/2004	92.0	
SR 202	Red Mountain		3		WB			11/04/2004	92.2	
SR 202	Red Mountain		4		WB			11/04/2004	91.9	
SR 202	Red Mountain		5		WB		104.3			
SR 202	Red Mountain		12		EB		100.9	11/04/2004		

Quiet Pavement Pilot Program
Site I (Mileposts) Data
12/07/05

ROUTE	ROAD NAME	ELEVATION	MP NUMBER	MP	DIRECTION	DATE1	BEFORE	DATE2	AFTER	REDUCTION
SR 202	Red Mountain		13		EB		103.3	11/04/2004	94.6	8.7
SR 202	Red Mountain		14		EB		103.8	11/04/2004	94.5	9.3
SR 202	Red Mountain		15		EB		103.9	11/04/2004	94.5	9.4
SR 202	Red Mountain		16		EB		99.4	11/04/2004	94.2	5.2
SR 202	Red Mountain		17		EB			11/04/2004	93.6	
SR 202	Red Mountain		18		EB		106.3	11/04/2004	93.1	13.2
SR 202	Red Mountain		19		EB		104.9	11/04/2004	93.5	11.4
SR 202	Red Mountain		20		EB		105.4	11/04/2004		
SR 202	Red Mountain		21		EB					
SR 202	Red Mountain		21.2		EB					
SR 202	Red Mountain		12		WB		100.6	11/04/2004	96.3	4.3
SR 202	Red Mountain		13		WB		102.1	11/04/2004	94.5	7.6
SR 202	Red Mountain		14		WB		104.2	11/04/2004	94.5	9.7
SR 202	Red Mountain		15		WB		103.8	11/04/2004	95.0	8.8
SR 202	Red Mountain		16		WB		103.9	11/04/2004	94.4	9.5
SR 202	Red Mountain		17		WB			11/04/2004	95.3	
SR 202	Red Mountain		18		WB		105.3	11/04/2004	95.4	9.9
SR 202	Red Mountain		19		WB		104.6	11/04/2004	92.9	11.7
SR 202	Red Mountain		20		WB		105.8	11/04/2004	93.9	11.9
SR 202	Red Mountain		21		WB					
SR 202	Red Mountain		21.2		WB					

Average Reduction	**8.3**

APPENDIX 3

Site 2 Data

Table I
QPPP Site 2 Results
Traffic Data
12/05/05

Route	Segment	HDR Receiver	Freeway	Receiver	Date	Time	Avg. Speed	Autos	Med. Trucks	Hvy Trucks	Buses	Motorcycles	Date	Time	Avg Speed	Autos	Med. Trucks	Hvy Trucks	Buses	Motorcycles	Comment
L101	A	1	Pima	1	07/30/2003	11:45am - 12:45pm	67	6652 (94.23%)	241 (3.41%)	166 (2.35%)			11/06/2003	30am - 12:30	65	4 (93.5	227 (3.05%)	253 (3.40%)			
L101	A	2	Pima	2	07/30/2003	11:45am - 12:45pm	65	6652 (94.23%)	241 (3.41%)	166 (2.35%)			01/29/2004	18am - 11:18	65	2 (93.3	321 (4.74%)	126 (1.86%)			
L101	A	3	Pima	3	07/30/2003	10:17am - 11:17am	65	5226 (92.92%)	302 (5.36%)	96 (1.70%)			11/06/2003	00am - 11:00	65	1 (93.3	207 (3.00%)	249 (3.61%)			
L101	A	4	Pima	4	07/30/2003	10:15am - 11:15am	65	5226 (92.92%)	302 (5.36%)	96 (1.70%)			01/27/2004	13am - 11:13	65	5 (92.1	486 (6.28%)	122 (1.57%)			
L101	A	5	Pima	5	08/05/2003	9:30am - 10:30am	65	6383 (93.44%)	215 (3.14%)	233 (3.41%)			01/28/2004	42am - 10:42a	65	1 (92.9	399 (5.12%)	152 (1.95%)			
L101	A	6	Pima	6	07/29/2003	11:00am - 12:00pm	65	6164 (93.60%)	313 (4.75%)	108 (1.64%)			01/28/2004	07am - 12:07	65	8 (92.9	431 (5.43%)	127 (1.60%)			
L101	A	7	Pima	7	08/05/2003	11:00am - 12:00pm	65	7086 (93.66%)	255 (3.37%)	224 (2.96%)			10/29/2003	02am - 12:02	65	8 (92.8	298 (4.35%)	194 (2.83%)			
L101	A	8	Pima	8	07/29/2003	11:05am - 12:05pm	65	6164 (93.60%)	313 (4.75%)	108 (1.64%)			10/29/2003	00am - 12:00	65	8 (92.8	298 (4.35%)	194 (2.83%)			
L101	A	9	Pima	9	07/29/2003	9:30am - 10:30am	65	6788 (93.17%)	349 (4.79%)	148 (2.03%)			10/29/2003	30am - 10:30a	65	0 (92.1	312 (4.59%)	221 (3.25%)			
L101	A	10	Pima	10	07/29/2003	9:30am - 10:30am	65	6788 (93.17%)	349 (4.79%)	148 (2.03%)			10/29/2003	33am - 10:33a	65	0 (92.1	312 (4.59%)	221 (3.25%)			
L101	A	11	Pima	11	07/29/2003	9:30am - 10:30am	65	9279 94.19%)	315 (3.19%)	257 (2.60%)			02/10/2004	27am - 11:27	65	5 (92.6	448 (5.50%)	151 (1.85%)			
SR51	B	1	Piestewa	12	08/07/2003	4:00pm - 5:00pm	65	9747 (98.45%)	115 (1.16%)	38 (0.38%)			10/19/2005	49pm - 4:49p	65	1 (97.1	239 (2.03%)	101 (0.86%)			
SR51	B	2	Piestewa	13	08/07/2003	4:00pm - 5:00pm	65	9747 (98.45%)	115 (1.16%)	38 (0.38%)			10/19/2005	51pm - 4:51p	65	1 (97.1	239 (2.03%)	101 (0.86%)			
SR51	B	3	Piestewa	14	08/12/2003	4:00pm - 5:00pm	65	8274 (97.68%)	160 (1.88%)	36 (0.42%)			10/26/2005	36pm - 4:46p	65	0 (96.7	214 (2.10%)	121 (1.19%)			
SR51	B	4	Piestewa	15	08/13/2003	4:00pm - 5:00pm	65	5703 (98.41%)	75 (1.29%)	17 (0.29%)			10/28/2003	15pm - 6:15p	65	6 (98.6	115 (1.16%)	17 (0.17%)			
SR51	B	5	Piestewa	16	08/13/2003	5:30pm - 6:30pm	65	5009 (99.22%)	31 (0.61%)	8 (0.15%)			10/28/2003	52pm - 4:52p	65	7 (97.3	180 (2.17%)	38 (0.45%)			
SR51	B	6	Piestewa	17	08/12/2003	5:30pm - 6:30pm	65	6449 (98.69%)	73 (1.11%)	12 (0.18%)			11/06/2003	41pm - 5:41p	65	8 (98.6	86 (1.15%)	14 (0.18%)			
SR51	B	7	Piestewa	18	08/12/2003	5:30pm - 6:30pm	65	6449 (98.69%)	73 (1.11%)	12 (0.18%)			09/18/2003	15pm - 6:15p	65	4 (98.8	77 (0.94%)	13 (0.15%)			
SR51	B	8	Piestewa	19	08/12/2003	4:00pm - 5:00pm	65	8274 (97.68%)	160 (1.88%)	36 (0.42%)			09/18/2003	45pm - 4:45p	65	5 (97.6	168 (1.99%)	32 (0.37%)			
SR51	B	9	Piestewa	20	08/12/2003	4:00pm - 5:00pm	65	8274 (97.68%)	160 (1.88%)	36 (0.42%)			10/26/2005	33pm - 4:33p	65	0 (96.7	214 (2.10%)	121 (1.19%)			
L101	C	1	Agua Fria	21	08/20/2003	6:40am - 7:40am	65	8761 (95.46%)	170 (1.85%)	246 (2.68%)			11/18/2003	44am - 7:44a	63	.7 (95.3	226 (2.28%)	232 (2.34%)			
L101	C	2	Agua Fria	22	08/20/2003	8:00am - 9:00am	65	8761 (95.46%)	170 (1.85%)	246 (2.68%)			05/13/2004	06am - 9:06a	65	.5 (94.0	301 (3.24%)	254 (2074%)			
L101	C	3	Agua Fria	23	08/28/2003	8:04am - 9:04am	65	6226 (94.11%)	181 (2.73%)	208 (3.14%)			05/13/2004	03am - 9:03a	65	1 (93.5	317 (3.71%)	233 (2.72%)			
L101	C	4	Agua Fria	24	08/21/2003	6:36am - 7:36am	65	7607 (95.14%)	142 (1.77%)	246 (3.07%)			05/13/2004	24am - 7:24a	65	5 (94.3	198 (2.22%)	302 (3.39%)			
L101	C	5	Agua Fria	25	08/21/2003	7:55am - 8:55am	65	5201(92.75%)	163 (2.90%)	243 (4.33%)			11/19/2003	35am - 7:35a	65	9 (93.0	233 (2.98%)	311 (3.98%)			
L101	C	6	Agua Fria	26	08/21/2003	7:55am - 8:55am	65	5201 (92.75%)	163 (2.90%)	243 (4.33%)			11/20/2003	58am - 8:58a	65	9 (94.1	184 (2.75%)	209 (3.12%)			
L101	C	7	Agua Fria	27	08/21/2003	6:37am - 7:37am	65	7607 (95.14%)	142 (1.77%)	246 (3.07%)			11/19/2003	51am - 8:51a	63	1 (93.7	221 (2.92%)	255 (3.36%)			
L101	C	8	Agua Fria	28	09/04/2003	6:30am - 7:30am	65	8926 (95.34%)	222 (2.37%)	214 (2.28%)			11/20/2003	32am - 7:32a	58	1 (96.0	135 (1.83%)	155 (2.10%)			
L101	C	9	Agua Fria	29	09/04/2003	7:50am - 8:50am	65	8120 (94.19%)	240 (2.78%)	260 (3.01%)			11/25/2003	58am - 8:58a	65	8 (95.0	218 (2.45%)	220 (2.48%)			
L101	C	10	Agua Fria	30	08/20/2003	6:40am - 7:40am	65	6840 (95.27%)	131 (1.82%)	208 (2.89%)			11/26/2003	28am - 7:28a	63	0 (93.1	176 (2.93%)	235 (3.91%)			
L101	D	1	Pima	31	09/30/2003	6:00am - 7:00am	65	8555 (94.32%)	323 (3.56%)	192 (2.11%)			01/28/2004	03am - 7:03a	65	2 (95.5	343 (3.59%)	83 (0.87%)			
L101	D	2	Pima	32	09/30/2003	6:00am - 7:00am	65	8555 (94.32%)	323 (3.56%)	192 (2.11%)			01/28/2004	02am - 7:02a	65	2 (95.5	343 (3.59%)	83 (0.87%)			
L101	D	3	Pima	33	10/02/2003	6:10am - 7:10am	65	8384 (94.97%)	276 (3.12%)	168 (1.90%)			01/01/2704	27am - 7:27a	65	8 (94.8	391 (4.06%)	106 (1.10%)			
L101	D	4	Pima	34	10/01/2003	6:02am - 7:02am	65	9835 (95.31%)	323 (3.13%)	160 (1.55%)			02/11/2004	00am - 7:00a	65	.9 (95.5	359 (3.68%)	71 (0.72%)			
L101	D	5	Pima	35	10/08/2003	6:05am - 7:05am	65	8047 (94.52%)	345 (4.05%)	121 (1.42%)			02/11/2004	02am - 7:02a	65	.9 (95.5	359 (3.68%)	71 (0.72%)			
L101	D	6	Pima	36	10/07/2003	6:10am - 7:10am	65	8794 (95.38%)	312 (3.38%)	113 (1.22%)			01/27/2004	24am - 7:24a	65	8 (94.8	391 (4.06%)	106 (1.10%)			
L101	D	7	Pima	37	10/07/2003	6:07am - 7:07am	65	7920 (95.03%)	244 (2.92%)	170 (2.03%)			01/28/2004	05am - 7:05a	65	2 (95.5	343 (3.59%)	83 (0.87%)			
L101	D	8	Pima	38	10/08/2003	6:00am - 7:00am	65	7761 (95.47%)	210 (2.58%)	158 (1.94%)			01/28/2004	02am - 7:02a	65	2 (95.5	343 (3.59%)	83 (0.87%)			
L202	E	1	Red Mountain	39	10/09/2003	8:51am - 9:51am	65	2200 (92.12%)	89 (3.72%)	99 (4.14%)			12/03/2003	11am - 10:11a	65	7 (92.6	75 (3.31%)	91 (4.02%)			
L202	E	2	Red Mountain	40	10/09/2003	10:23am - 11:23am	65	1830 (92.56%)	74 (3.74%)	73 (3.69%)			12/04/2003	47am - 10:47a	65	8 (93.3	62 (3.03%)	75 (3.66%)			
L202	E	3	Red Mountain	41	10/09/2003	10:20am - 11:20am	65	1830 (92.56%)	74 (3.74%)	73 (3.69%)			12/04/2003	45am - 10:45a	65	8 (93.3	62 (3.03%)	75 (3.66%)			
L202	E	4	Red Mountain	42	10/08/2003	2:08pm - 3:08pm	65	2764 (94.81%)	80 (2.74%)	71 (2.43%)			10/29/2003	46pm - 2:46p	65	9 (92.6	140 (4.87%)	70 (2.43%)			
L202	E	5	Red Mountain	43	10/09/2003	8:50am - 9:50am	65	2200 (92.12%)	89 (3.72%)	99 (4.14%)			12/03/2003	10am - 10:10a	65	7 (92.6	75 (3.31%)	91 (4.02%)			
L202	E	6	Red Mountain	44	10/09/2003	8:52am - 9:52am	65	2200 (92.12%)	89 (3.72%)	99 (4.14%)			12/03/2003	10am - 10:10a	65	7 (92.6	75 (3.31%)	91 (4.02%)			
L101	F	1	Price	45	02/11/2004	2:00pm - 3:00pm	65	9,579	333	76			11/10/2004	00pm - 3:00p	65	10,336	312	212			
L101	F	2	Price	46	02/11/2004	3:30pm - 4:30pm	65	7,459	166	52			11/10/2004	30pm - 4:30p	65	10,307	277	96			
L101	F	3	Price	47	02/10/2004	3:46pm - 4:46pm	65	7,403	160	56			11/04/2004	16pm - 4:16p	65	7,101	170	44	2	33	
L101	F	4	Price	48	02/11/2004	3:39pm - 4:29pm	65	7,459	166	52			11/10/2004	31pm - 4:31p	65	10,307	277	96			
L101	F	5	Price	49	02/10/2004	2:17pm - 3:17pm	65	9,828	276	60			11/04/2004	03pm - 3:03p	65	8,122	264	88	11	36	
L101	F	6	Price	50	02/12/2004	1:57pm - 2:57pm	65	10,147	327	59			11/02/2004	35pm - 3:35p	65	12,245	382	75	5	35	
L101	F	7	Price	51	02/11/2004	1:59pm - 2:59pm	65	9,579	333	76			11/16/2004	00pm - 3:00p	65	10,056	327	214			
L202	G	1	Red Mountain	52	03/09/2004	7:55pm - 8:55pm	70	3,304	60	13			11/17/2004	00pm - 9:00p	65	5,029	73	63			
L202	G	2	Red Mountain	53	03/09/2004	9:16pm - 10:16pm	70	1,712	47	11			06/16/2005	10pm - 10:10p	65	1,741	25	7			
L202	G	3	Red Mountain	54	03/18/2004	8:55pm - 9:55pm	70	2,190	42	5			11/18/2004	00pm - 9:00p	65	2,744	28	6			
L202	G	4	Red Mountain	55	04/21/2005	5:56am - 6:56am	70	3,126	55	41					65	5,561	117	69	36	38	1
I-10	H	1	Maricopa	56	03/23/2004	10:03am - 11:03am	65	14,148	699	468			11/17/2004	03am - 11:03	65	12,795	627	632	14	28	
I-10	H	2	Maricopa	57	03/24/2004	1:37pm - 2:37pm	65	17,680	689	461											2
I-10	H	3	Maricopa	58	03/25/2004	9:57am - 10:57am	65	12,816	556	575			11/18/2004	06am - 11:06	65	12,811	614	610	16	37	
I-10	H	4	Maricopa	59	03/23/2004	1:11pm - 2:11pm	65	14,604	829	436			11/17/2004	30pm - 2:30p	65	14,698	742	485	14	86	
I-10	H	5	Maricopa	60	03/34/2004	9:21am - 10:21am	65	14,305	544	518			11/02/2004	49am-10:49a	65	15,198	368	631	36	31	
L101	J	1	Pima	61	04/29/2004	4:58am - 5:58am	65	6,510	232	158			08/10/2004	05am - 6:05a	65	5,628	287	124	10	19	
L101	J	2	Pima	62	04/27/2004	5:05am - 6:05am	65	6,779	214	217			07/27/2004	09am - 6:09a	65	5,666	327	113	10	22	
L101	J	3	Pima	63	04/27/2004	5:05am - 6:05am	65						11/18/2004	57am - 5:57a	65	4,285	206	153			3

Table I
QPPP Site 2 Results
Traffic Data
12/05/05

Route	Segment	HDR Receiver	Freeway	Receiver	Date	Time	Avg. Speed	Autos	Med. Trucks	Hvy Trucks	Buses	Motorcycles	Date	Time	Avg Speed	Autos	Med. Trucks	Hvy Trucks	Buses	Motorcycles	Comment
L101	J	4	Pima	64	04/30/2004	5:00am - 6:00am	65	5,359	182	115			08/11/2004	10am - 6:10a	65	4,857	234	103	6	20	
I-10	K	1	Papago	65	06/17/2004	8:28am - 9:29am	65	8,391	481	1,069											2
I-10	K	2	Papago	66	06/16/2004	12:05pm - 1:05pm	65	11,302	654	1,144			05/19/2005	55am - 11:55	65	11102	480	992	38	42	
I-10	K	3	Papago	67	06/03/2004	1:10pm - 2:10pm	65	16,099	626	1,060			05/03/2005	28pm - 2:28p	65	13,916	491	969	44	51	
I-10	K	4	Papago	68	06/17/2004	11:34am - 12:34pm	65	11,150	614	1,141			06/21/2005	01am - 12:01	65	11,983	486	1,080	33	27	
I-10	K	5	Papago	69	06/17/2004	9:55am - 10:55am	65	8,037	427	1,102			05/19/2005	30am - 10:20a	65	8436	460	1046	25	22	
I-10	L	1	Maricopa	70	09/29/2004	4:52am - 5:52am	65	8,948	452	567	8	22	09/27/2005	40am - 6:40a	65	11142	684	540	54	18	
I-10	L	2	Maricopa	71	09/30/2004	6:06am - 7:06am	65	9,112	399	469	27	74	09/29/2005	56am - 6:56a	65	8421	235	603	31	56	
I-10	L	3	Maricopa	72	09/28/2004	5:50am - 6:50am	65	8695	224	574	36	56	09/01/2005	45am - 6:45a	65	12288	508	936	41	68	
I-17	M	1	Black Canyon	73	09/14/2004	4:05am - 5:05am	65	3,586	131	220			07/06/2005	04am - 5:04a	65	3186	151	218			
L101	N	1	Pima	74	06/08/2004	6:10am - 7:12am	65	7,253	282	106	3	40	05/19/2005	59am - 6:59a	65	5,394	152	84	14	33	
L101	O	1	Price	75	10/06/2004	1:42pm - 2:42pm	65	12,579	234	166	44	30	09/20/2005	08pm - 4:08p	65	12039	190	233	19	27	
L101	O	2	Price	76	10/07/2004	2:19pm - 3:19pm	65	12,435	310	122			09/20/2005	39pm - 2:39p	65	11688	240	216	24	30	
SR143	P	1	Hohokam	77	09/15/2004	2:02pm - 3:02pm															1
L202	Q	1	Red Mountain	78	08/18/2004	1:35pm - 2:35pm	65	13,411	270	158	36	12	06/21/2005	09pm - 2:09p	65	12,164	274	251	17	30	
L202	Q	2	Red Mountain	79	08/19/2004	1:54pm - 2:54pm	65	13,736	520	168	13	33									2
L202	Q	3	Red Mountain	80	08/24/2004	1:48pm - 2:48pm	65	13672	502	164	15	28	08/11/2005	:30pm-3:30pm							1
L202	Q	4	Red Mountain	81	08/25/2004	2:03pm - 3:03pm							09/01/2005	23pm - 2:23pm							1
L101	R	1	Agua Fria	82	03/16/2005	3:14pm-4:14pm	65	8,997	134	127	21	34	08/03/2005	:14pm-4:14pr	65	7602	141	143	20	18	
L101	R	2	Agua Fria	83																	2
L101	R	3	Agua Fria	84	04/13/2005	3:30pm-4:30pm	65	9,409	115	177	18	32	08/04/2005	:03pm-4:03pr	65	8423	179	204	18	24	
L101	R	4	Agua Fria	85	03/22/2005	2:56pm-3:56pm	65	10,136	229	191	24	38	09/28/2005	50pm - 3:50p	65	8421	235	603	31	56	
L101	R	5	Agua Fria	86	04/12/2005	3:03pm-4:03pm	65	8,084	238	224	21	56									4
L101	S	1	Pima	87	08/04/2005	6:05am-7:05am	65	7,599	219	179	4	38	10/06/2005	59am - 6:59a	65	8229	204	298	8	56	
L101	S	2	Pima	88	08/04/2005	7:30am-8:30am	65	9,275	168	123	4	19	10/06/2005	18am - 8:18a	65	7984	92	212	9	24	

Comments

1. QA/QC by HDR determined traffic counts may be inconsistent. Video tapes are being reviewed to confirm traffic counts. A noise reduction was not determined because After Leq measurements have not been normalized for traffic differences.
2. Unable to complete post-ARFC noise measurement due to external noise source not present during the pre-ARFC noise measurement.
3. Post-ARFC traffic counts not recorded due to camera or tape malfunction.
4. ARFC could not be applied to a section of SR 101 (Agua Fria) near Mileposts 4 and 5 until roadway repairs are completed.

Table II
QPPP Site 2 Results
Meteorolgy and Noise Measurements
12/05/05

Route	Segment	HDR Receiver	Freeway	Receiver	Date	Time	Temp (^{0}F)	Wind (mph)	Wind Direction	Humidity (%)	Lmin	Lmax	Leq	Date	Time	Temp (^{0}F)	Wind (mph)	Wind Direction	Humidity (%)	Lmin	Lmax	Leq	Pre Leq	Post Leq	Reduction	Comment
L101	A	1	Pima	1	07/30/2003	11:45am - 12:45pm	94.0	1.1	Variable	37.6	62.7	81.5	74.6	11/06/2003	11:30am - 12:30pm	75.9	0.4	Northeast	15.1	60.2	81.0	69.8	74.6	69.3	5.3	
L101	A	2	Pima	2	07/30/2003	11:45am - 12:45pm	92.0	1.4	Variable	40.6	60.0	72.2	64.3	01/29/2004	10:18am - 11:18am	59.7	1.0	Northeast	25.1	49.7	68.4	55.5	64.3	55.7	8.6	
L101	A	3	Pima	3	07/30/2003	10:17am - 11:17am	92.9	1.2	Northeast	36.7	59.0	72.4	64.6	11/06/2003	10:00am - 11:00am	74.1	1.0	Northeast	18.4	52.1	69.5	59.7	64.6	58.5	6.1	
L101	A	4	Pima	4	07/30/2003	10:15am - 11:15am	92.2	2.2	Variable	39.2	61.2	76.8	66.5	01/27/2004	10:13am - 11:13am	68.1	1.7	South	16.9	53.8	77.7	60.6	66.5	59.2	7.3	
L101	A	5	Pima	5	08/05/2003	9:30am - 10:30am	96.0	2.8	Variable	20.0	50.3	69.9	55.6	01/28/2004	9:42am - 10:42am	59.8	1.7	Northeast	23.8	47.7	59.7	52.5	55.6	52.2	3.4	
L101	A	6	Pima	6	07/29/2003	11:00am - 12:00pm	90.5	3.2	Variable	34.0	52.6	70.1	59.3	01/28/2004	11:07am - 12:07pm	71.9	1.3	Southeast	16.1	49.1	72.4	57.0	59.3	56.1	3.2	
L101	A	7	Pima	7	08/05/2003	11:00am - 12:00pm	99.8	1.6	Southwest	16.0	51.1	75.9	60.7	10/29/2003	11:02am - 12:02pm	79.7	1.2	Southeast	17.7	47.5	76.7	58.0	60.7	58.4	2.3	
L101	A	8	Pima	8	07/29/2003	11:05am - 12:05pm	97.7	2	Variable	32.3	56.7	78.6	64.9	10/29/2003	11:00am - 12:00pm	83.3	4.1	Southeast	20.0	51.2	73.3	59.5	64.9	59.1	5.8	
L101	A	9	Pima	9	07/29/2003	9:30am - 10:30am	92.2	2.1	Variable	37.0	63.3	84.0	73.1	10/29/2003	9:30am - 10:30am	76.1	5.4	Variable	21.7	59.5	83.3	69.6	73.1	69.6	3.5	
L101	A	10	Pima	10	07/29/2003	9:30am - 10:30am	94.6	1.6	Variable	36.9	63.2	79.9	69.0	10/29/2003	9:33am - 10:33am	76.7	3.1	Variable	21.3	58.4	78.6	65.5	69.0	65.5	3.5	
L101	A	11	Pima	11	07/29/2003	9:30am - 10:30am	90.7	2.3	Variable	35.9	63.5	81.0	70.1	02/10/2004	10:27am - 11:27am	66.6	1.0	East	11.1	58.4	80.6	66.7	70.1	67.5	2.6	
SR51	B	1	Piestewa	12	08/07/2003	4:00pm - 5:00pm	108.4	2.1	Variable	16.3	59.8	71.7	64.2	10/19/2005	3:49pm - 4:49pm	75.4	0.8	North	34.4	55.2	71.7	60.2	64.2	59.2	5.0	
SR51	B	2	Piestewa	13	08/07/2003	4:00pm - 5:00pm	108.4	2.1	Variable	16.3	60.7	76.9	66.3	10/19/2005	3:51pm - 4:51pm	78.4	1.4	West	29.4	55.6	81.5	63.3	66.3	63.3	4.0	
SR51	B	3	Piestewa	14	08/12/2003	4:00pm - 5:00pm	108.5	3.3	Northwest	16.6	63.9	73.1	68.4	10/26/2005	3:36pm - 4:46pm	80.1	2.6	North	27.4	53.8	68.0	59.5	68.4	58.4	10.0	
SR51	B	4	Piestewa	15	08/13/2003	4:00pm - 5:00pm	111.0	1.1	Variable	14.9	62.6	76.7	67.4	10/28/2003	5:15pm - 6:15pm	71.0	N/A	N/A	24.1	54.1	69.3	59.9	67.4	57.6	9.8	
SR51	B	5	Piestewa	16	08/13/2003	5:30pm - 6:30pm	106.7	1.8	Variable	20.3	60.8	70.9	65.6	10/28/2003	3:52pm - 4:52pm	85.0	1.2	Variable	12.3	53.7	70.2	59.4	65.6	57.0	8.6	
SR51	B	6	Piestewa	17	08/12/2003	5:30pm - 6:30pm	104.4	1.3	West	18.6	56.9	73.8	63.0	11/06/2003	4:41pm - 5:41pm	83.0	N/A	N/A	19.3	53.3	71.7	60.8	63.0	60.2	2.8	
SR51	B	7	Piestewa	18	08/12/2003	5:30pm - 6:30pm	101.1	0.8	Variable	19.4	57.5	68.0	62.4	09/18/2003	5:15pm - 6:15pm	94.9	1.8	West	9.6	52.5	78.9	58.8	62.4	57.9	4.5	
SR51	B	8	Piestewa	19	08/12/2003	4:00pm - 5:00pm	106.4	3.5	Variable	18.0	56.9	69.6	62.8	09/18/2003	3:45pm - 4:45pm	98.6	2.7	Variable	8.3	51.6	69.5	58.6	62.8	58.6	4.2	
SR51	B	9	Piestewa	20	08/12/2003	4:00pm - 5:00pm	106.2	1.1	Variable	17.0	52.0	71.6	57.4	10/26/2005	3:33pm - 4:33pm	82.3	0.3	East	27.3	50.3	70.6	56.0	57.4	54.9	2.5	
L101	C	1	Agua Fria	21	08/20/2003	6:40am - 7:40am	84.1	0.87	Southwest	57.7	60.2	72.6	64.3	11/18/2003	6:44am - 7:44am	54.0	N/A	N/A	61.9	57.2	72.4	62.5	64.3	62.2	2.1	
L101	C	2	Agua Fria	22	08/20/2003	8:00am - 9:00am	87.4	0.7	East	51.9	58.8	76.4	65.2	05/13/2004	8:06am - 9:06am	70.0	0.2	North	34.3	53.5	75.0	63.4	65.2	63.2	2.0	
L101	C	3	Agua Fria	23	08/28/2003	8:04am - 9:04am	85.0	0.9	Variable	61.1	60.2	75.8	65.9	05/13/2004	8:03am - 9:03am	65.3	0.2	Variable	25.0	55.3	74.9	64.7	65.9	64.7	2.3	
L101	C	4	Agua Fria	24	08/21/2003	6:36am - 7:36am	86.4	1.3	West	54.7	57.7	66.2	62.2	05/13/2004	6:24am - 7:24am	54.8	0.3	North	35.1	50.7	63.8	55.8	62.2	55.2	7.0	
L101	C	5	Agua Fria	25	08/21/2003	7:55am - 8:55am	88.5	1.1	Variable	14.9	58.6	69.6	63.2	11/19/2003	6:35am - 7:35am	65.6	1.5	Variable	29.4	57.7	72.6	64.5	63.2	63.1	0.1	
L101	C	6	Agua Fria	26	08/21/2003	7:55am - 8:55am	86.4	1.8	West	56.1	52.9	71.2	58.5	11/20/2003	7:58am - 8:58am	63.5	N/A	N/A	37.3	49.7	68.0	57.1	58.5	56.7	1.8	
L101	C	7	Agua Fria	27	08/21/2003	6:37am - 7:37am	93.5	1.3	Variable	62.9	61.4	76.0	67.7	11/19/2003	7:51am - 8:51am	59.5	1.1	Variable	36.4	55.7	70.3	60.5	67.7	60.6	7.1	
L101	C	8	Agua Fria	28	09/04/2003	6:30am - 7:30am	86.0	1.3	Variable	55.7	57.7	85.0	72.4	11/20/2003	6:32am - 7:32am	53.4	N/A	N/A	56.6	59.2	76.3	66.1	72.4	67.2	5.2	
L101	C	9	Agua Fria	29	09/04/2003	7:50am - 8:50am	91.3	2.0	Variable	44.3	64.2	77.7	69.6	11/25/2003	7:58am - 8:58am	55.8	1.6	Northwest	24.9	61.9	77.1	69.1	69.6	69.1	0.5	
L101	C	10	Agua Fria	30	08/20/2003	6:40am - 7:40am	84.5	1.1	Variable	57.3	67.5	83.3	73.9	11/26/2003	6:28am - 7:28am	44.8	0.4	Southwest	40.1	60.8	82.5	72.6	73.9	73.0	0.9	
L101	D	1	Pima	31	09/30/2003	6:00am - 7:00am	72.3	Calm	Calm	51.1	58.5	68.5	61.9	01/28/2004	6:03am - 7:03am	42.1	0.3	West	83.9	50.5	66.7	55.7	61.9	55.8	6.1	
L101	D	2	Pima	32	09/30/2003	6:00am - 7:00am	73.4	Calm	Calm	39.0	55.2	65.0	58.8	01/28/2004	6:02am - 7:02am	42.1	0.3	West	83.9	48.8	64.8	53.5	58.8	53.6	5.2	
L101	D	3	Pima	33	10/02/2003	6:10am - 7:10am	74.6	Calm	Calm	48.9	61.8	69.9	64.7	01/01/2704	6:27am - 7:27am	34.3	Calm	Calm	88.4	55.5	64.7	59.0	64.7	58.8	5.9	
L101	D	4	Pima	34	10/01/2003	6:02am - 7:02am	73.0	0.2	East	39.1	60.5	67.4	64.0	02/11/2004	6:00am - 7:00am	38.8	Calm	Calm	59.6	55.0	64.0	58.1	64.0	58.5	5.5	
L101	D	5	Pima	35	10/08/2003	6:05am - 7:05am	64.1	Calm	Calm	71.1	55.1	75.7	59.3	02/11/2004	6:02am - 7:02am	38.8	Calm	Calm	59.6	52.3	60.3	55.9	59.3	55.5	3.8	
L101	D	6	Pima	36	10/07/2003	6:10am - 7:10am	74.7	Calm	Calm	38.0	62.1	70.8	66.9	01/27/2004	6:24am - 7:24am	34.3	Calm	Calm	88.4	56.7	65.4	61.3	66.9	61.1	5.8	
L101	D	7	Pima	37	10/07/2003	6:07am - 7:07am	75.3	Calm	Calm	42.9	58.9	71.8	64.4	01/28/2004	6:05am - 7:05am	42.1	0.3	West	83.9	52.3	70.6	57.2	64.4	56.9	7.5	
L101	D	8	Pima	38	10/08/2003	6:00am - 7:00am	67.7	0.2	West	68.4	54.2	67.9	60.8	01/28/2004	6:02am - 7:02am	42.1	0.3	West	83.9	47.0	63.3	52.5	60.8	52.0	8.8	
L202	E	1	Red Mountain	39	10/09/2003	8:51am - 9:51am	84.3	4.4	Variable	29.4	56.6	69.1	63.1	12/03/2003	9:11am - 10:11am	60.0	0.7	East	28.4	46.8	66.2	54.2	63.1	54.5	8.6	
L202	E	2	Red Mountain	40	10/09/2003	10:23am - 11:23am	92.3	2.1	Variable	24.6	49.4	70.1	58.0	12/04/2003	9:47am - 10:47am	65.9	3.7	Northeast	19.0	42.8	65.2	52.7	58.0	52.6	5.4	
L202	E	3	Red Mountain	41	10/09/2003	10:20am - 11:20am	92.3	2.1	Variable	24.6	50.2	69.0	57.9	12/04/2003	9:45am - 10:45am	65.9	3.7	Northeast	19.0	43.1	63.6	51.4	57.9	51.9	6.6	
L202	E	4	Red Mountain	42	10/08/2003	2:08pm - 3:08pm	92.3	1.5	South	28.1	50.6	66.5	58.8	10/29/2003	1:46pm - 2:46pm	88.3	1.6	Variable	13.0	46.1	65.6	52.4	58.8	52.3	6.5	
L202	E	5	Red Mountain	43	10/09/2003	8:50am - 9:50am	84.3	4.4	Variable	29.4	53.2	72.6	60.5	12/03/2003	9:10am - 10:10am	60.0	0.7	East	28.4	43.6	74.3	57.0	60.5	57.3	3.2	
L202	E	6	Red Mountain	44	10/09/2003	8:52am - 9:52am	84.3	4.4	Variable	29.4	53.3	71.5	60.4	12/03/2003	9:10am - 10:10am	60.0	0.7	East	28.4	48.1	62.2	52.7	60.4	53.0	7.4	
L101	F	1	Price	45	02/11/2004	2:00pm - 3:00pm	65.1	1.3	Variable	16.1	58.2	74.2	63.3	11/10/2004	2:00pm - 3:00pm	71.3	0.8	Variable	34.4	50.7	73.0	60.3	63.3	59.6	3.7	
L101	F	2	Price	46	02/11/2004	3:30pm - 4:30pm	64.4	1.3	Variable	17.6	58.1	67.9	61.7	11/10/2004	3:30pm - 4:30pm	70.2	1.7	Variable	31.4	51.5	74.2	58.9	61.7	57.4	4.3	
L101	F	3	Price	47	02/10/2004	3:46pm - 4:46pm	66.3	0.8	Northeast	20.7	56.7	73.5	64.1	11/04/2004	3:16pm - 4:16pm	81.3	0.9	West	13.7	54.3	71.7	60.3	64.1	60.4	3.7	
L101	F	4	Price	48	02/11/2004	3:39pm - 4:29pm	64.4	1.3	Variable	17.6	65.0	77.5	68.7	11/10/2004	3:31pm - 4:31pm	70.2	1.7	Variable	31.4	57.0	76.1	63.9	68.7	62.4	6.3	
L101	F	5	Price	49	02/10/2004	2:17pm - 3:17pm	71.6	1.1	South	7.3	55.3	65.4	59.6	11/04/2004	2:03pm - 3:03pm	82.6	1.7	Variable	12.1	46.2	60.9	51.1	59.6	51.6	8.0	
L101	F	6	Price	50	02/12/2004	1:57pm - 2:57pm	70.0	0.8	Variable	11.0	56.9	69.6	62.1	11/02/2004	2:35pm - 3:35pm	81.1	1.9	South	10.8	53.1	67.8	58.9	62.1	58.0	4.1	
L101	F	7	Price	51	02/11/2004	1:59pm - 2:59pm	65.1	1.3	Variable	16.1	59.8	72.8	64.9	11/16/2004	2:00pm - 3:00pm	73.8	1.2	North West	35.6	49.2	69.5	56.7	64.9	56.1	8.8	
L202	G	1	Red Mountain	52	03/09/2004	7:55pm - 8:55pm	76.7	0.6	South	28.0	58.0	70.9	63.6	11/17/2004	8:00pm - 9:00pm	61.0	0.0	N/A	59.0	52.7	69.9	58.8	63.6	56.7	6.9	
L202	G	2	Red Mountain	53	03/09/2004	9:16pm - 10:16pm	73.2	1.6	Variable	29.4	57.0	69.8	62.8	06/16/2005	9:10pm - 10:10pm	91.1	4.1	North East	14.1	44.7	62.3	50.4	62.8	50.5	12.3	
L202	G	3	Red Mountain	54	03/18/2004	8:55pm - 9:55pm	70.9	0.3	South	33.1	54.5	66.3	60.5	11/18/2004	8:00pm - 9:00pm	61.5	0.0	N/A	56.3	44.8	63.9	52.2	60.5	51.3	9.2	
L202	G	4	Red Mountain	55	04/21/2005	5:56am - 6:56am	55.6	1.4	Variable	33.6	66.7	73.4	70.7							52.6	68.4	57.7	70.7			1

Table II
QPPP Site 2 Results
Meteorolgy and Noise Measurements
12/05/05

Route	Segment	HDR Receiver	Freeway	Receiver	Date	Time	Temp (^{0}F)	Wind (mph)	Wind Direction	Humidity (%)	Lmin	Lmax	Leq	Date	Time	Temp (^{0}F)	Wind (mph)	Wind Direction	Humidity (%)	Lmin	Lmax	Leq	Pre Leq	Post Leq	Reduction	Comment
I-10	H	1	Maricopa	56	03/23/2004	10:03am - 11:03am	86.4	3.8	North	23.9	62.2	72.3	65.7	11/17/2004	10:03am - 11:03am	76.0	0.9	North West	29.4	58.6	67.1	62.0	65.7	62.0	3.7	
I-10	H	2	Maricopa	57	03/24/2004	1:37pm - 2:37pm	93.2	0.7	Variable	13.9	66.8	75.6	70.3										70.3			2
I-10	H	3	Maricopa	58	03/25/2004	9:57am - 10:57am	83.3	1.1	Variable	20.4	62.5	73.1	65.8	11/18/2004	10:06am - 11:06am	78.8	1.0	South East	32.7	55.3	70.1	60.0	65.8	59.9	5.9	
I-10	H	4	Maricopa	59	03/23/2004	1:11pm - 2:11pm	89.9	1.0	Variable	18.3	66.0	73.1	68.7	11/17/2004	1:30pm - 2:30pm	85.0	1.5	South East	24.2	58.0	68.6	62.6	68.7	62.5	6.2	
I-10	H	5	Maricopa	60	03/34/2004	9:21am - 10:21am	80.1	1.3	West	26.9	65.4	72.9	67.8	11/02/2004	9:49am-10:49am	74.5	0.7	North	13.0	56.4	69.0	60.8	67.8	60.5	7.3	
L101	J	1	Pima	61	04/29/2004	4:58am - 5:58am	71.7	3.5	Southwest	40.4	56.9	67.0	60.3	08/10/2004	5:05am - 6:05am	86.1	0.9	South	36.4	53.5	66.5	57.3	60.3	57.8	2.5	
L101	J	2	Pima	62	04/27/2004	5:05am - 6:05am	77.4	0.8	Northwest	23.6	60.3	67.8	63.9	07/27/2004	5:09am - 6:09am	85.1	0.0	South	47.3	49.3	62.9	55.1	63.9	55.9	8.0	
L101	J	3	Pima	63	04/27/2004	5:05am - 6:05am	80.1	2.6	ESE	12.3	56.3	67.3	60.3	11/18/2004	4:57am - 5:57am	55.8	N/A	N/A	76.1	44.6	61.0	49.8	60.3			3
L101	J	4	Pima	64	04/30/2004	5:00am - 6:00am	62.1	0.8	South	33.7	48.2	67.5	56.8	08/11/2004	5:10am - 6:10am	86.2	0.0	N/A	38.4	44.8	65.3	55.2	56.8	55.4	1.4	
I-10	K	1	Papago	65	06/17/2004	8:28am - 9:29am	93.6	1	Variable	23.4	56.7	71.3	61.1													2
I-10	K	2	Papago	66	06/16/2004	12:05pm - 1:05pm	103.5	0.9	West	12.9	62.6	72.5	66.4	05/19/2005	10:55am - 11:55am	93.5	2.2	East	17.9	55.9	70.4	60.7	66.4	61.1	5.3	
I-10	K	3	Papago	67	06/03/2004	1:10pm - 2:10pm	105.9	2.8	East	8.7	58.5	73.9	64.4	05/03/2005	1:28pm - 2:28pm	91.6	3.8	North East	15.7	54.7	78	61.6	64.4	62.1	2.3	
I-10	K	4	Papago	68	06/17/2004	11:34am - 12:34pm	99.2	9.3	Variable	17.3	62.5	76.3	67.3	06/21/2005	11:01am - 12:01pm	106.7	1.4	West	15.2	54.2	66.4	59.3	67.3	59.3	8	
I-10	K	5	Papago	69	06/17/2004	9:55am - 10:55am	93.1	1.6	Variable	24.3	59.1	67.6	62.1	05/19/2005	9:30am - 10:20am	84.6	1.8	South	21.2	51.4	70.1	56.5	62.1	56.5	5.6	
I-10	L	1	Maricopa	70	09/29/2004	4:52am - 5:52am	79.3	0.1	Variable	64.2	60.8	73.0	66.7	09/27/2005	5:40am - 6:40am	83.2	N/A	N/A	34.2	55.7	70.7	61.6	66.7	60.9	5.8	
I-10	L	2	Maricopa	71	09/30/2004	6:06am - 7:06am	62.7	N/A	N/A	55.5	58.1	68.5	63.2	09/29/2005	5:56am - 6:56am	71.1	0.2	South	27.1	52.6	64.6	57.6	63.2	57.6	5.6	
I-10	L	3	Maricopa	72	09/28/2004	5:50am - 6:50am	71.1	N/A	N/A	45.2	61.7	69.3	65.2	09/01/2005	5:45am - 6:45am	80.2	N/A	N/A	53.7	56.2	65.5	59.9	65.2	58.1	7.1	
I-17	M	1	Black Canyon	73	09/14/2004	4:05am - 5:05am	82.7	0.3	South East	30	59.0	71.3	65.6	07/06/2005	4:04am - 5:04am	82.3	0.2	Southwest	15.1	53.4	66.9	59.4	65.6	59.7	5.9	
L101	N	1	Pima	74	06/08/2004	6:10am - 7:12am	79.5	0.6	Variable	22.7	51.6	70.6	58.9	05/19/2005	5:59am - 6:59am	69.7	N/A	N/A	40.2	50.6	71.9	58.8	58.9	60.2	-1.3	
L101	O	1	Price	75	10/06/2004	1:42pm - 2:42pm	96.7	0.1	North West	17.1	53.5	67.8	59.2	09/20/2005	3:08pm - 4:08pm	99.3	0.3	South	20.3	49.2	68.3	57.2	59.2	57.3	1.9	
L101	O	2	Price	76	10/07/2004	2:19pm - 3:19pm	94.2	1.4	Variable	10.6	56.1	68.6	61.7	09/20/2005	1:39pm - 2:39pm	101.9	0.6	South	19.9	48.3	70.7	56.5	61.7	56.5	5.2	
SR143	P	1	Hohokam	77	09/15/2004	2:02pm - 3:02pm	99.2	3.4	North	15.9	52.4	68.4	60.2													1
L202	Q	1	Red Mountain	78	08/18/2004	1:35pm - 2:35pm	103.9	5.7	Variable	19.2	63.6	74.8	68.9	06/21/2005	1:09pm - 2:09pm	107.6	2	East	13.5	54.4	70.1	58.7	68.9	58.8	10.1	
L202	Q	2	Red Mountain	79	08/19/2004	1:54pm - 2:54pm	97.1	3.3	Variable	22.5																2
L202	Q	3	Red Mountain	80	08/24/2004	1:48pm - 2:48pm	98.2	0.7	Variable	22.8	57.4	72.3	64.3	08/11/2005	2:30pm-3:30pm	94.1	1.3	Variable	42.2	53.4	69.3	59.4				1
L202	Q	4	Red Mountain	81	08/25/2004	2:03pm - 3:03pm	100.3	3	Variable	17.5	58.0	73.0	65.7	09/01/2005	1:23pm - 2:23pm	105.3	2.2	Northeast	22	53.2	70.2	58.6				1
L101	R	1	Agua Fria	82	03/16/2005	3:14pm-4:14pm	73	1.7	Variable	11	50.5	66.6	57.4	08/03/2005	3:14pm-4:14pm	93.4	1.4	North	41.3	49.6	64	56.2	57.4	56.8	0.6	
L101	R	2	Agua Fria	83																						2
L101	R	3	Agua Fria	84	04/13/2005	3:30pm-4:30pm	95.4	3.2	North	8	52.3	70.0	61.2	08/04/2005	3:03pm-4:03pm	107.4	2.4	North	28.6	50.1	64.1	56.4	61.2	56.6	4.6	
L101	R	4	Agua Fria	85	03/22/2005	2:56pm-3:56pm	80.4	1.8	Northeast	19.7	61.7	72.2	67.6	09/28/2005	2:50pm - 3:50pm	97.2	3.4	North	10.9	57.4	72.2	62.3	67.6	61.7	5.9	
L101	R	5	Agua Fria	86	04/12/2005	3:03pm-4:03pm	91	1	South	11.6	65.8	74.1	70.0													4
L101	S	1	Pima	87	08/04/2005	6:05am-7:05am	79.5	1.6	Variable	72.0	69.8	77.6	74.0	10/06/2005	5:59am - 6:59am	68.0	1.2	North	44.7	57.9	71.9	62.9	74.0	62.2	11.8	
L101	S	2	Pima	88	08/04/2005	7:30am-8:30am	88.3	1.5	Variable	46.7	65.5	78.5	71.0	10/06/2005	7:18am - 8:18am	80.2	0.5	North	31.0	57.6	71.6	63.3	71.0	63.6	7.4	

Average Noise Level Reduction	**5.3**

Comments

1. QA/QC by HDR determined traffic counts may be inconsistent. Video tapes are being reviewed to confirm traffic counts. A noise reduction was not determined because After Leq measurements have not been normalized for traffic differences.
2. Unable to complete post-ARFC noise measurement due to external noise source not present during the pre-ARFC noise measurement.
3. Post-ARFC traffic counts not recorded due to camera or tape malfunction.
4. ARFC could not be applied to a section of SR 101 (Agua Fria) near Mileposts 4 and 5 until roadway repairs are completed.

APPENDIX 4

Site 3 Data

AZ and FHWA QPPP
Type 3 Site Measurements (also includes some community measurements)

Site 3B
Rte. 101 Peoria AZ (adjacent to and including Sun Valley Elementary School)

Wayside measurements are being performed to help assess the noise effect of adding a 1-in ARFC overlay on top of uniform transversely tined PCC, no joints.

The type of wayside measurements is time-averaged, where sound levels are continuously measured at various distances from the roadway, then both 5 and 15 minute data blocks are examined.

Oct-05

To date, two sets of data have been collected: June 2004 with the PCC (existing pavement) and August 2005 with the ARFC (post overlay).

Three more sets of data will be collected to assess the longevity of the effect of ARFC on noise (planned for June 2006, June 2008, June 2011).

Results discussed at this point have not been normalized for traffic variations. In other words, differences in sound level due to traffic variations have not yet been accounted for.

It is possible that normalizing for traffic conditions may have very little effect on the end results (since traffic is fairly consistent at this site), but results will be provided upon completion.

Upon initial assessment of the ARFC compared to the transversely tined PCC with no joints, results are showing at 50 ft from the road, ARFC has reduced the highway traffic noise by about 8.7 dBA.

95 ft from the road, ARFC has reduced the highway traffic noise by about 6.7 dBA.

At the ball field in the school adjacent to the highway (246 ft from road), ARFC has reduced the highway noise by about 8.2 dBA.

In the portable classroom at the school, ARFC has reduced the highway noise by 2.0 dBA with the classroom door open and the air conditioning assumed to be on.

With the classroom door closed, there seems to be very little effect from the pavement, if any.

On the stage of the amphitheater at the school, ARFC has reduced the highway noise by about 4.5 dBA.

Regarding the pavement effect in terms of spectral content, there is noticeable effect from 630 Hz and up.

At all locations except the classroom, the largest effect from the pavement is seen in the frequency range of 1000-2000 Hz, an important range for reducing the overall sound level.

There is a difference in the amount of pavement effect at these locations, due to the frequency content -- the more the frequency range of 1000-2000 Hz contributed to the overall sound level for the PCC data, the more the effect of the ARFC will show. For the classroom data, it is apparent that the air conditioning spectral content has changed from 2004 to 2005; there is now a loud tone around 100 Hz that is heavily contributing to the overall sound level. This affects both the closed and open door results, where the strong pavement effect is still apparent in the 1000-2000 Hzrange but it's contributions are little if any. The pavement effect is also apparent with the air conditioning off, but the unaffected lower frequencies are primarily controlling the overall sound level.

It should be noted that the increase in high frequencies from PCC to ARFC (post overlay) for some of the measurement locations is due to the insect (cicadas) noise during the measurements for ARFC (post overlay). The insect noise did not contribute to the overall sound level.

This spreadsheet contains a summary of research quality (type 3) measurements and analysis for the AZ and FHWA QPPP

Site 3B
Rte. 101 Peoria AZ (adjacent to and including Sun Valley Elementary School)

Status of measurements and analysis as of 10/2005

	pavement type	date of measurements	noise analysis	traffic analysis
existing pavement	transversely tined PCC, no joints	6/17/2004	completed	completed
post overlay	ARFC	8/24/2005	in progress*	in progress
post overlay - 1 year	ARFC			
post overlay - 3 years	ARFC			
post overlay - 6 years	ARFC			

Tabs in spreadsheet	description
measured_overall	measured overall sound levels; all positions* includes 5- and 15-minute averages includes pavement benefit deltas (quiet pavement sound level minus existing pavement sound level)
measured_spectral	measured spectral data; all positions* includes 5- and 15-minute averages includes pavement benefit deltas (quiet pavement sound level minus existing pavement sound level)
spectral plot 50ft	plot of spectral levels for the 50-ft position* based on 5-minute averages
spectral plot 95ft	plot of spectral levels for the 95-ft position* based on 5-minute averages
spectral plot ball field	plot of spectral levels for the ball field position (246 ft)* based on 5-minute averages
spectral plot class closedACon	plot of spectral levels for the classroom position, door to classroom closed, AC on* based on 5-minute averages
spectral plot class closedACoff	plot of spectral levels for the classroom position, door to classroom closed, AC off* based on 5-minute averages
spectral plot class open	plot of spectral levels for the classroom position, door to classroom open, AC presumed on* based on 5-minute averages
spectral plot amphitheater	plot of spectral levels for the amphitheater position* based on 5-minute averages

*data has not yet been normalized in terms of traffic (i.e., differences in sound level due to traffic variations have not yet been accounted for) - this analysis is in progress.

Site 3B

Rte. 101 Peoria AZ (adjacent to and including Sun Valley Elementary School)

measurement side of highway	SB	3 lanes transversely tined PCC, no joints
opposite side of highway	NB	3 lanes transversely tined PCC, no joints

Microphone locations

ID	distance from center of near lane	height
1	50 ft	10 ft above ground, 5 ft above road elevation
2	95 ft	5 ft above ground
3	246 ft, ball field (Sun Valley Elementary School)	5 ft above ground
4	offset from mic line, inside portable classroom #710 (Sun Valley Elementary School)	2.75 ft above ground (ANSI S12.60)
5	offset from mic line, amphitheater (Sun Valley Elementary School)	5 ft above ground

RESULTS SUMMARY - measured levels (when available, post overlay measurements will here be shown not calibrated for traffic differences)

5-minute averages

Overall sound levels (also see "over time plot 5 min" tab)

			Average LAeq5min			door closed, AC on	door closed, AC off	door open	
	pavement type	date of measurements	mic 1, 50 ft	mic 2, 95 ft	mic 3, ball field	mic 4, classroom	mic 4, classroom	mic 4, classroom	mic 5, amphitheater
existing pavement	transversely tined PCC, no joints	6/17/2004	82.9	77.0	70.3	45.4	40.2	52.9	68.0
post overlay	ARFC overlay, 2-3 months age	8/24/2005	74.1	70.2	62.0	47.0	39.5	50.9	63.6
post overlay - 1 year	ARFC								
post overlay - 3 years	ARFC								
post overlay - 6 years	ARFC								

Pavement benefits - deltas (overlay minus existing)

			LAeq5min delta			door closed, AC on	door closed, AC off	door open	
	pavement type	date of measurements	mic 1, 50 ft	mic 2, 95 ft	mic 3, ball field	mic 4, classroom	mic 4, classroom	mic 4, classroom	mic 5, amphitheater
post overlay	ARFC overlay, 2-3 months age	8/24/2005	-8.7	-6.7	-8.2	1.7	-0.8	-2.0	-4.5
post overlay - 1 year	ARFC								
post overlay - 3 years	ARFC								
post overlay - 6 years	ARFC								

15-minute averages

low number of samples

Overall sound levels

			Average LAeq15min			door closed, AC on	door closed, AC off	door open	
	pavement type	date of measurements	mic 1, 50 ft	mic 2, 95 ft	mic 3, ball field	mic 4, classroom	mic 4, classroom	mic 4, classroom	mic 5, amphitheater
existing pavement	transversely tined PCC, no joints	6/17/2004	82.9	76.9	70.3	47.1	40.0	52.9	68.1
post overlay	ARFC overlay, 2-3 months age	8/24/2005	74.1	70.2	62.0	46.6	39.8	51.1	63.7
post overlay - 1 year	ARFC								
post overlay - 3 years	ARFC								
post overlay - 6 years	ARFC								

Pavement benefits - deltas (overlay minus existing)

			LAeq15min delta			door closed, AC on	door closed, AC off	door open	
	pavement type	date of measurements	mic 1, 50 ft	mic 2, 95 ft	mic 3, ball field	mic 4, classroom	mic 4, classroom	mic 4, classroom	mic 5, amphitheater
post overlay	ARFC overlay, 2-3 months age	8/24/2005	-8.7	-6.7	-8.3	-0.5	-0.3	-1.8	-4.4
post overlay - 1 year	ARFC								
post overlay - 3 years	ARFC								
post overlay - 6 years	ARFC								

AZ and FHWA QPPP
Type 3 Site Measurements (also includes some community measurements)

Site 3C
Rte. 10 Phoenix AZ (adjacent to and including Mountain Vista Park)

Wayside measurements are being performed to help assess the noise effect of adding a 1-in ARFC overlay on top of uniform transversely tined PCC, with joints.

The type of wayside measurements is time-averaged, where sound levels are continuously measured at various distances from the roadway, then both 5 and 15 minute data blocks are examined.

Oct-05 To date, two sets of data have been collected: June 2004 with the PCC (existing pavement) and June 2005 with the ARFC (post overlay).

Three more sets of data will be collected to assess the longevity of the effect of ARFC on noise (planned for June 2006, June 2008, June 2011).

Results discussed at this point have not been normalized for traffic variations. In other words, differences in sound level due to traffic variations have not yet been accounted for.

It is possible that normalizing for traffic conditions may have very little effect on the end results (since traffic is fairly consistent at this site), but results will be provided upon completion.

Upon initial assessment of the ARFC compared to the transversely tined PCC with joints, results are showing at 50 ft from the road, ARFC has reduced the highway traffic noise by about 7.7 dBA.

At the volleyball court in the park adjacent to the highway, ARFC has reduced the highway traffic noise by about 5.6 dBA.

Regarding the pavement effect in terms of spectral content, there is some effect from 300-500 Hz, then it starts increasing at 630 Hz.

At both 50 ft and in the volleyball court (141 ft), the largest effect from the pavement is seen in the frequency range of 1000 - 2000 Hz, an important range for reducing the overall sound level.

The pavement effect is greater at 50 ft than at the volleyball court (141 ft) because the frequencies that are being affected most by the ARFC are less important farther from the road.

This spreadsheet contains a summary of research quality (type 3) measurements and analysis for the AZ and FHWA QPPP

Site 3C
Rte. 10 Phoenix AZ (adjacent to and including Mountain Vista Park)

Status of measurements and analysis as of 10/2005

	pavement type	date of measurements	pavement age	noise analysis	traffic analysis
existing pavement	transversely tined PCC, with joints	6/16/2004		completed	completed
post overlay	ARFC	6/7/2005	EB 7 months, WB 3 months	in progress*	completed
post overlay - 1 year	ARFC				
post overlay - 3 years	ARFC				
post overlay - 6 years	ARFC				

Tabs in spreadsheet	description
measured_overall	measured overall sound levels; all positions* includes 5- and 15-minute averages includes pavement benefit deltas (quiet pavement sound level minus existing pavement sound level)
measured_spectral	measured spectral data; all positions* includes 5- and 15-minute averages includes pavement benefit deltas (quiet pavement sound level minus existing pavement sound level)
spectral plot 50ft	plot of spectral levels for the 50-ft position* based on 5-minute averages
spectral plot volleyball	plot of spectral levels for the volleyball court position* based on 5-minute averages

*data has not yet been normalized in terms of traffic (i.e., differences in sound level due to traffic variations have not yet been accounted for) - this analysis is in progress.

Site 3C

Rte. 10 Phoenix AZ (adjacent to and including Mountain Vista Park)

measurement side of highway	EB	4 lanes plus exit lane 1-in ARFC overlay on transversely tined PCC, with joints
opposite side of highway	WB	4 lanes 1-in ARFC overlay on transversely tined PCC, with joints

Microphone locations

ID	distance from center of near lane (exit lane)	height
1	50 ft	9.5 ft above ground, 5 ft above road elevation
2	141 ft, offset 39 ft from 50-ft line in sand volleyball court (Mountain Vista Park)	5 ft above ground

RESULTS SUMMARY - measured levels (when available, post overlay measurements will here be shown not calibrated for traffic differences)

5-minute averages

Overall sound levels (also see "over time plot 5 min" tab)

	pavement type	date of measurements	pavement age	Average LAeq5min mic 1, 50 ft	Average LAeq5min mic 2, volleyball court
existing pavement	transversely tined PCC, with joints	6/16/2004		82.9	72.4
post overlay	ARFC, 2-7 months age	6/7/2005	EB 7 months, WB 3 months	75.2	66.9
post overlay - 1 year	ARFC				
post overlay - 3 years	ARFC				
post overlay - 6 years	ARFC				

Pavement benefits - deltas (overlay minus existing)

	pavement type	date of measurements		LAeq5min delta mic 1, 50 ft	LAeq5min delta mic 2, volleyball court
post overlay	ARFC, 2-7 months age	6/7/2005	EB 7 months, WB 3 months	-7.7	-5.6
post overlay - 1 year	ARFC				
post overlay - 3 years	ARFC				
post overlay - 6 years	ARFC				

15-minute averages

Overall sound levels

	pavement type	date of measurements	pavement age	Average LAeq15min mic 1, 50 ft	Average LAeq15min mic 2, volleyball court
existing pavement	transversely tined PCC, with joints	6/16/2004		82.9	72.4
post overlay	ARFC, 2-7 months age	6/7/2005	EB 7 months, WB 3 months	75.3	66.9
post overlay - 1 year	ARFC				
post overlay - 3 years	ARFC				
post overlay - 6 years	ARFC				

Pavement benefits - deltas (overlay minus existing)

	pavement type	date of measurements		LAeq15min delta mic 1, 50 ft	LAeq15min delta mic 2, volleyball court
post overlay	ARFC, 2-7 months age	6/7/2005	EB 7 months, WB 3 months	-7.6	-5.6
post overlay - 1 year	ARFC				
post overlay - 3 years	ARFC				
post overlay - 6 years	ARFC				